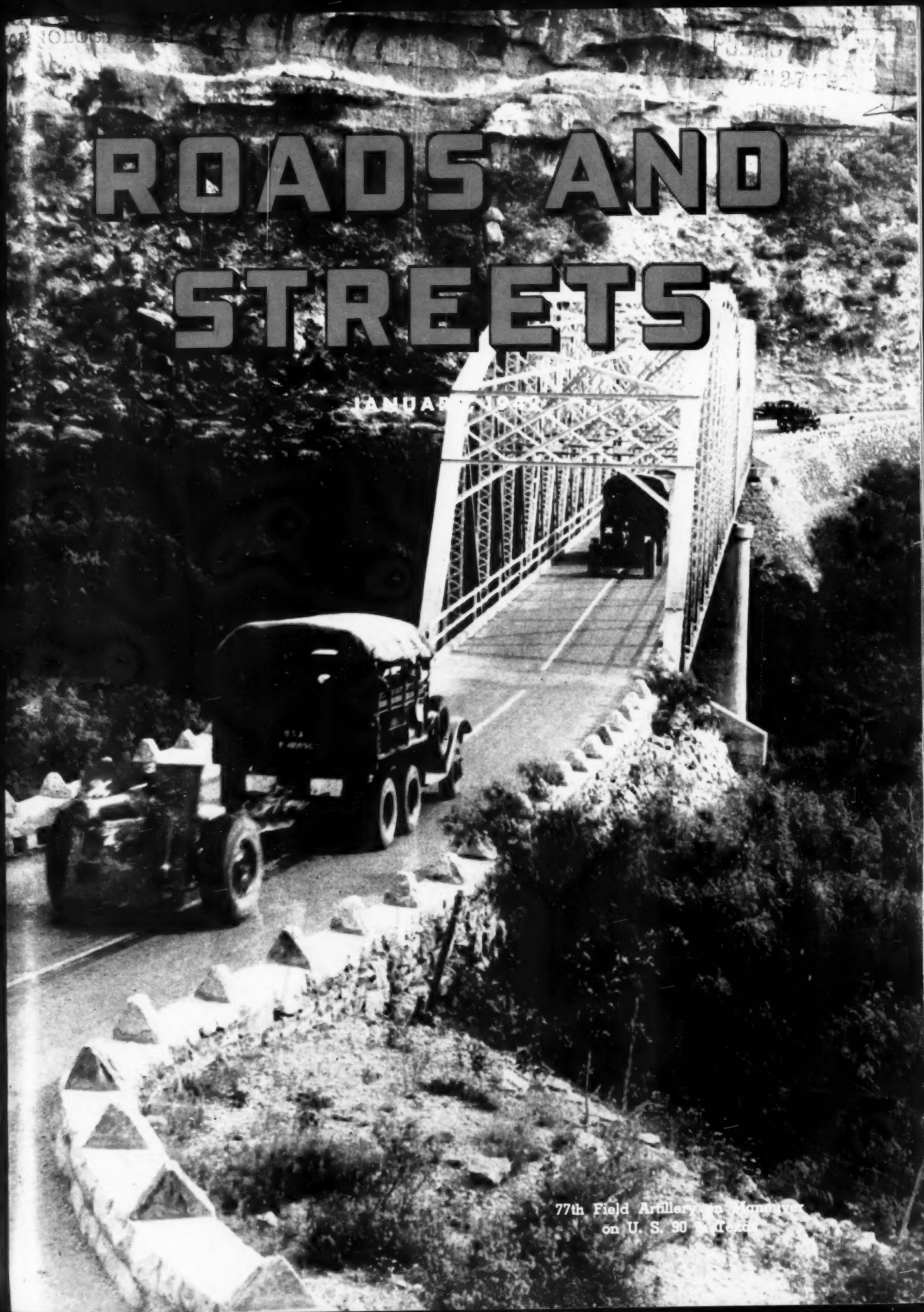
ROADS AND STREETS



77th Field Artillery [illegible] Maneuver
on U. S. 90 [illegible]

AFRICAN DESERT...

OR DAKOTA SNOW

Model LTR three-augur SNOGO *mounted on Marmon-Herrington* All-Wheel-Drive *Truck.*

it's all the same to a MARMON-HERRINGTON *All-Wheel-Drive*

● In the torturous service with British forces in Libya—across heat-seared, wheel-churned desert sand, hundreds of Marmon-Herrington *All-Wheel-Drive* converted Fords contributed greatly to the speed of attack which gave Australian and New Zealand troops the advantage in their bold venture.

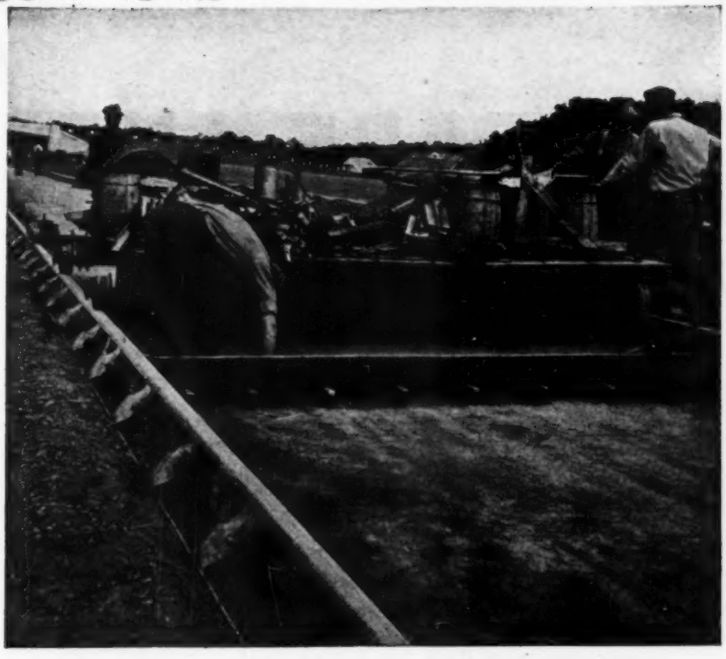
But, sensational as the performance of these trucks has been in military service, it is no surprise to thousands of men in the oil fields, on snow-removal crews, in road building and maintenance, and in utility services, at home and abroad. These men, who have the world's most difficult transportation jobs to do, have learned to depend on Marmon-Herrington *All-Wheel-Drives* for brilliant performance, where no other trucks could operate at all. Write for new catalog just off the press.

Marmon-Herrington Heavy-Duty All-Wheel-Dr *are built in capacities up to 35 tons. Four, or six wh driving. Gasoline or Diesel power.*

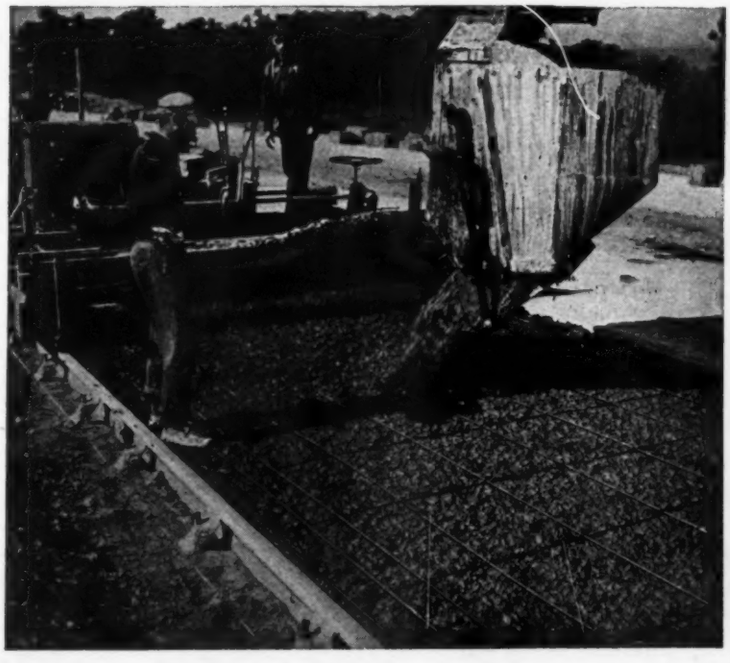
MARMON-HERRINGTON COMPANY, Inc.

Cable Address: MARTON • INDIANAPOLIS, INDIANA, U.S.A.

Construction steps lively



WHEN YOU ORDER BETHLEHEM ROAD STEEL



When you order all your road steel requirements from Bethlehem, it's easier to keep highway construction moving smoothly.

Here's why that's true whether you're building a short connecting road or an interstate artery.

Bethlehem Road Steel Service supplies you with all the road steel products you need for any construction job. Bar mats, reinforcing bars, road joints, highway cable guard, steel posts, steel sheet piling and steel H-piling and many other products made by Bethlehem combine the latest design improvements with outstanding economy.

You save three ways by placing all your requirements for road steel with Bethlehem. Road steel is delivered when you want it. A single order eliminates unnecessary bookkeeping, correspondence or telephoning. A combined shipment usually saves you on freight charges, particularly when you can get delivery from a Bethlehem warehouse near you in miles and minutes.

Bethlehem has established a special service to handle your road steel requirements quickly and efficiently—to make sure you get better value for the money you spend on road steel. Before you start your next contract, write, phone or wire Bethlehem Steel Company, Bethlehem, Pa., and ask for details on Bethlehem Road Steel Service.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

ROADS AND STREETS

Vol. 85, No. 1 • January, 1942

CONTENTS

ROADS AND STREETS

CCA

A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations; and to the construction and maintenance of airports.

WITH ROADS AND STREETS HAVE BEEN COMBINED GOOD ROADS MAGAZINE AND ENGINEERING & CONTRACTING

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Watch a Northwest in tough digging and you see at once why it's a *Real* Rock Shovel. With a Northwest, there is no *stuttering "second start" digging* to fill the dipper.

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It's a REAL ROCK SHOVEL

—and when you have a Real Rock Shovel you won't have to worry about output in any digging!

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NORTHWEST

Built in a Range of 18 Sizes, 3/8 Cu. Yd. Capacity and Larger

FLIES at Candler Field, Atlanta, ... six Tournapulls took over ... earthmoving. Here's a Model ... Tournapull high-balling 11 heaped yards to the fill at 14 m.p.h. 4 LeTourneau 13-yard Carryalls and 2 'Dozers are handling the shorter hauls on this 1,380,000-yard defense project for C. M. Lyle Const. Co.

NOW

MORE THAN EVER

FOR MORE YARDAGE AND LOWER COSTS

ON LONG HAULS YOU NEED TOURNAPULLS

Tournapulls extend tractor - scraper economies to your longer hauls. Like big-capacity LeTourneau Carryalls, they are quickly pusher loaded. They haul at fast construction speeds (up to 14.3 m.p.h.) and spread their own loads, thus eliminate shovels and elevating graders for loading and 'dozers for spreading out the fill.

More Traction — High Average Speeds

Tournapull weight (plus 40% of the Carryall *and its load*) is centered on the drive wheels to give you the greatest possible tractive power. That means plenty of surplus rimpull for quick acceleration to top speed or for pulling through tough spots. Result—*high average speeds* and more *big* loads hourly.

Easy, Simple Operation

Just as tiller wheels have been discarded on track-type tractors, so LeTourneau has eliminated front steering wheels on Tournapulls. You pull and steer with the same wheels, just as you do with tracks on a track-type tractor. There are no front wheels to bog down when traveling or turning in mud or sand. Two-wheel design enables you to turn faster and sharper. Big brakes on both Tournapull and Carryall assure quick stopping and complete control on grades. Same fast, sure-acting LeTourneau cable control that has proved so popular on tractors, makes Tournapull-Carryall operation easy, too.

400 Model C's in Use

Today more than 400 Model C and Super C Tournapulls are in use, cutting costs on long hauls for hard headed, profit-minded earthmovers in 37 states and several foreign countries. Tournapulls can do the same for you — see your LeTourneau-"Caterpillar" distributor for complete details NOW

Loading common earth on the level with a "Caterpillar" D8 pusher and hauling over good roadways, you can expect the following yardages in a 60-minute hour from Tournapulls:

THESE PROFIT-MAKING YARDAGES CAN BE YOURS WITH TOURNAPULLS

Haul-One Way	98 H.P Model C (11 yards heaped)		150 H.P. Super C (15 yards heaped)	
	Trips	Pay Yards	Trips	Pay Yards
600	17.1	150	15.0	180
1200	14.0	119	12.0	144
1600	12.3	104	10.7	129
2000	10.9	93	9.7	116
3000	8.4	71	7.6	91
5000	5.8	50	5.4	65

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For Lowest Net Cost per Yard—CARRYALL* SCRAPERS, ANGLEDOZERS*, POWER CONTROL UNITS, BULLDOZERS, ROOTERS*, TRACTOR CRANES, PUSHDOZERS, TOURNAPULLS*, SHEEP'S FOOT ROLLERS, TOURNATRAILERS*, TOURNACRANE.

*Name Reg. U. S. Pat. Off.

In the months ahead, snowplows and all types of road machinery will need fast, accurate, dependable controls — and you'll need Blackhawk Hydraulic Power Packers to control them . . . In most cases, Power Packers eliminate having an extra man in the cab — thus freeing him for other vital defense work and "Multiplying America's Man-Power!" . . . Modernize your equipment with Blackhawk Power Packers now. Easily and quickly installed. For complete list of advantages, write your equipment manufacturer — or write us direct.

***A Product of* BLACKHAWK MFG. CO., Dept. RS, Milwaukee, Wisconsin**

Setting a Pace FOR Two 34E PAVERS

Buckeye R-B POWER FINEGRADER

at FORT KNOX, Kentucky

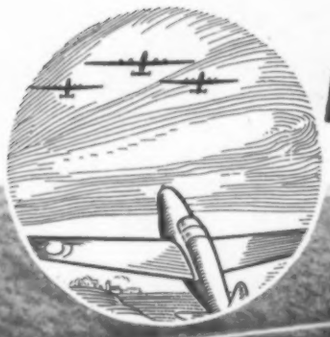
BUILDING finegrade ahead of two Single Drum 34-E Pavers is a job that demands speed and more speed, but the R-B Power Finegrader illustrated here is doing that in its stride. It's leading the parade with a clean, smooth accurate grade well out ahead of the pavers. The job is at Fort Knox, Ky., with the Breslin Construction Co., Louisville, and White Consolidated, Inc., Chicago, putting in 245,000 sq. yds. of 11, 22, 33, and 44 ft. roads—all finegrading done by Buckeye R-B machines. On hundreds of similar paving jobs—roads, airport runways, proving grounds — Buckeye R-B Power Finegraders are cutting the grade right on the payline, saving time, money and material. . . . . You'll profit by putting Buckeye R-B Finegraders on your paving jobs. Write *for new Bulletin Today!*

BUCKEYE TRACTION DITCHER COMPANY, Findlay, Ohio

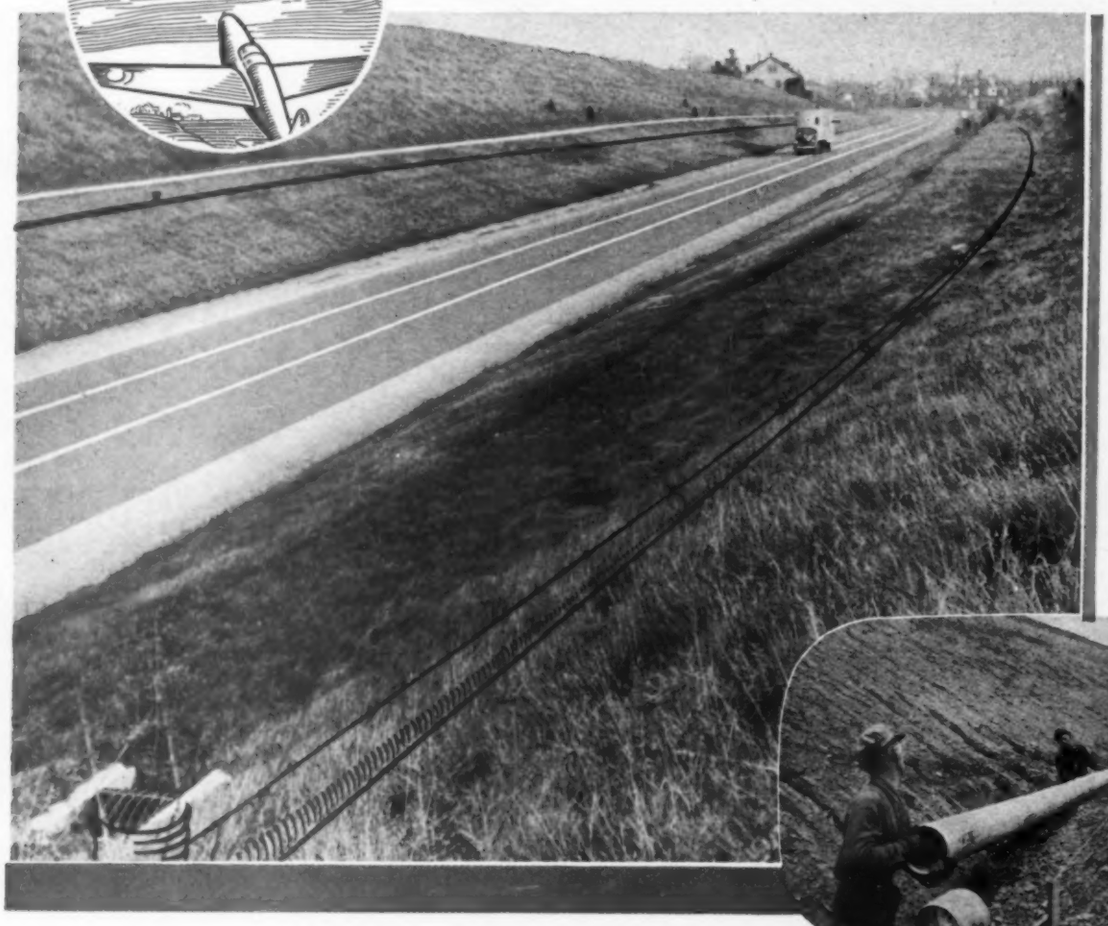
Built by Buckeye

CONVERTIBLE SHOVELS, TRENCHERS AND BACKFILLERS, TRACTOR EQUIPMENT, R-B FINEGRADERS, ROAD WIDENERS AND SPREADERS

CHECK PAGE 69



HIGHWAYS need interceptors, too!



• *Installation of Corrugated Metal Pipe is quick and easy, from simple designs.*

JUST as interceptor planes are needed to meet the enemy before it locates and destroys its objective, so, also, do many highways need interceptors — perforated drains in cuts, shallow fills and side hill slopes —to collect harmful ground water before it weakens the highway foundation.

Above is a typical example of a Corrugated Perforated Pipe installation that gives soil stabilization in a highway cut. The long lengths and tightly connected joints of the pipe, plus its great strength, assures perfect and permanent alignment. The perforations were designed to permit rapid infiltration of ground water, yet their size and shape prevent choking from backfills. In this particular installation the interceptor drainage will have long life because the pipe is of Toncan Copper Molybdenum Iron . . . the most rust-resistant ferrous metal in its price class.

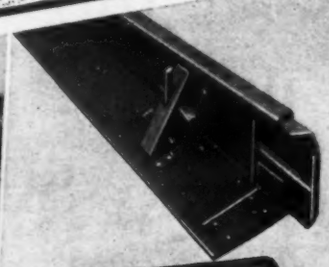
Iron and steel are vital metals, more especially now, and *Production for Victory* must come first. Eventually, however, Corrugated Metal Pipe will again be freely available for drainage systems everywhere. Remember the many distinct advantages of this modern drainage pipe. The Toncan Culvert Manufacturers Association, Republic Building, Cleveland, Ohio.

The alloy iron that gives drainage structures better service, longer life.

TONCAN IRON

PRODUCT OF REPUBLIC STEEL

TAMPING ROLLERS



ROAD FORMS

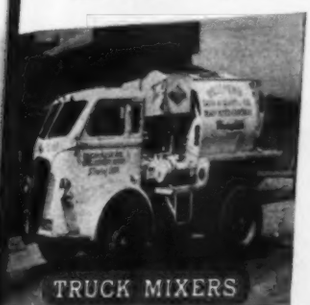
CURB AND GUTTER FORMS

TRUCK TURNTABLES

BLAW-KNOX

CONSTRUCTION EQUIPMENT

Gives you production . . . and profit



TRUCK MIXERS

High-speed production and dependable, trouble-free operation is built into any item of Blaw-Knox Construction equipment you buy. You will get the latest, the most up-to-date development—*the best*—for Blaw-Knox is always a step ahead.

Phone, wire or write for descriptive literature and prices.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
Farmer's Bank Building Pittsburgh, Pa.
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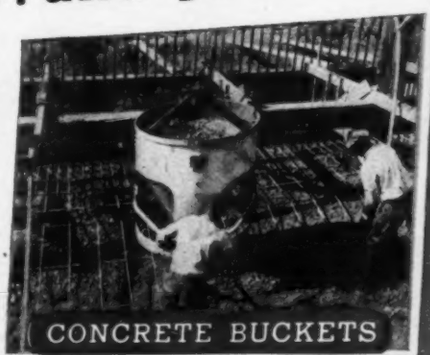
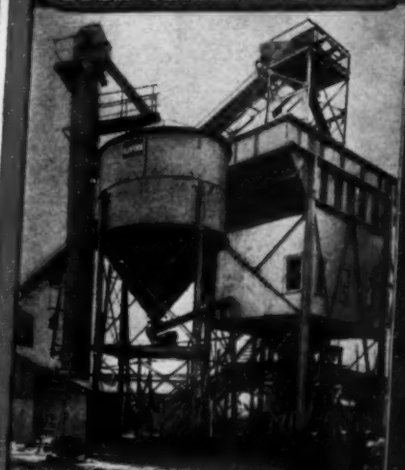


CONCRETE BUCKETS

BULK CEMENT PLANTS

CONCRETE SPREADERS

ROAD FINISHING MACHINES



CENTRAL MIXING PLANTS

SPREADER-VIBRATORS

TRUCK MIXER LOADING PLANTS

CLAMSHELL BUCKETS

WELDED CONSTRUCTION *Proved* AND *Improved!*

Written into the records on thousands of jobs — under all digging conditions — is the outstanding success of this more modern construction with both upper and lower structures each welded into a rigid unit of rolled alloy steel.

There remains no reasonable doubt about the advantages of this design, originated and developed by P&H to a far greater extent than is found in any other excavator.

P&H

General Offices: 4496 West National Avenue, Milwaukee, Wisconsin

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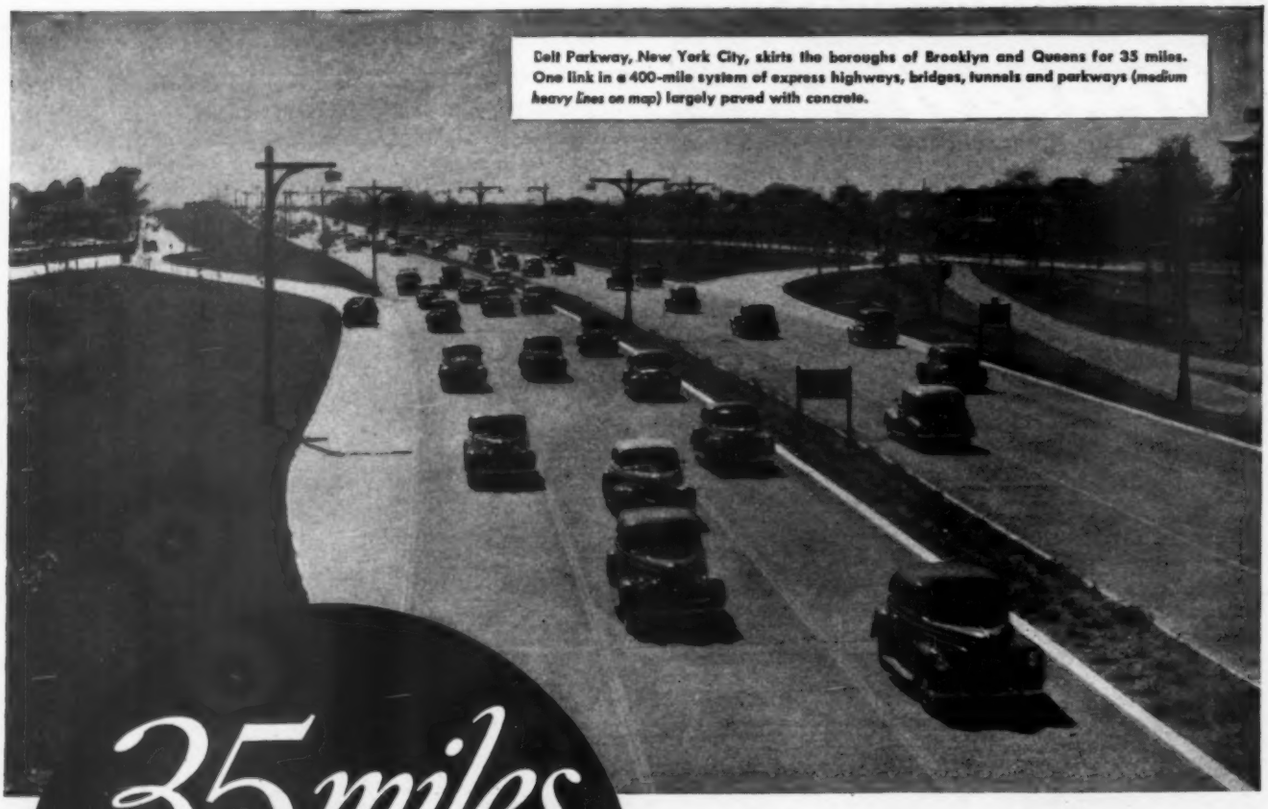
EXCAVATORS • ELECTRIC CRANES • ARC WELDERS P&H HOISTS • WELDING ELECTRODES • MOTORS

M-O-O-T-H-E-R than any excavator you er ran. Try P&H's Hydraulic control.



Belt Parkway, New York City, skirts the boroughs of Brooklyn and Queens for 35 miles. One link in a 400-mile system of express highways, bridges, tunnels and parkways (*medium heavy lines on map*) largely paved with concrete.

35 miles without a stop-light!

—and *concrete* all the way

One of the nation's outstanding examples of safe highway design is New York City's new Belt Parkway. Three features greatly reduce the chances of accidents on this heavily traveled artery:

1. All cross traffic eliminated by 52 grade separation bridges.
2. Limited access—parallel service roads for local traffic.
3. Safe roadway surface assured economically for decades by a divided pavement of skid-resistant *Concrete*.

Life-saving, time-saving express arteries like Belt Parkway are an economic necessity in every congested area today.

Enable communities to enjoy the traffic relief and business growth express highways bring. The need is urgent!

Send today for new booklet, *"Express Highways —How They Serve Millions of Motorists,"* mailed free on request in the U. S. or Canada.

PORTLAND CEMENT ASSOCIATION
Dept. 1-28, 33 West Grand Ave., Chicago, Ill.

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

The New Arsenals of Democracy

Wielding a major influence along the entire defense construction front are hundreds of MARION cranes, shovels, draglines and clamshells, all doing their "bit" in speeding up material handling and furthering the cause of democracy. An inventory of MARIONS in action would reveal them: digging foundations for industrial and munition plants; spotting girders for steel erection; clearing for roadbeds, army camps, naval bases and airports; erecting munition dumps; building bridges; making way for dry docks; moving great yardage on reclamation projects and dam sites. In these and many other ways MARION machines are contributing to the Nation's defense effort, thus making it possible for the new arsenals of democracy to swing into action faster.

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MARION, OHIO, U. S. A.

Offices in all principal cities

Serving industry since 1884

MARION

SHOVELS • DRAGLINES • CLAMSHELLS
CRANES • PULL-SHOVELS • WALKERS

Gasoline — Diesel — Electric — ¾ cubic yard to 35 cubic yards

ATHEY *Announces the*

FORCE-FEED LOADER . . .

for Highway Maintenance and Construction

Now, you can salvage material from road or street construction—and use it to good advantage elsewhere. That's the job the new Athey Force-Feed Loader does. Pulled by a motor grader, truck or tractor, this efficient unit scoops up wide windrows of earth, or other material, left on the road surface in grading or maintaining operations and conveys it into a truck which is loaded "on the move".

Thus, valuable material is saved for use in filling low places, for widening or resurfacing other roads, for slope trimming, for loading of top soil, stockpile loading, for landscaping, and many other uses. And drainage ditches can easily be cleaned of washed-in materials with this handy Athey loader.

The operation of the Force-Feed Loader is fast, simple and thorough. A gasoline engine drives the floating-feeder blades and conveyor, provides ample power to move dirt, rocks, brush, and other types of materials, quickly and economically.

Get further information on either the Tow-type or the Self-Propelled Force-Feed Loader—use the coupon below which, of course, incurs no obligation.

SEND FOR FREE FOLDER TODAY

We will gladly send you, without cost, an illustrated and descriptive folder showing the Force-Feed Loader at work on a variety of jobs. Just send in the coupon at the right.

ATHEY

TEAR OUT AND MAIL COUPON

Athey Truss Wheel Co.
5631 W. 65th Street
Chicago, Illinois

Please send me the new Force-Feed Loader folder.

We are interested in the Force-Feed Loader for th following uses:_____

Signed_____

Address_____

City_____

RS-142

"Tough and Stable

GULF LUBRICANTS

are a big help on a tough job like this"

. . . says Contractor on Mountain Highway Project

"Thanks to Gulf Quality Oils and Greases, we're getting efficient, low-cost performance from our equipment."

"WE'VE learned from experience that proper lubrication with tough-filmed Gulf lubricants plays an important part in the rapid completion of a contract," says contractor on mountain road project. "On a job like this, for example, our equipment gets full protection under the most punishing conditions. Result: We avoid costly delays from mechanical failures, and secure efficient, low-cost performance."

If you want the same efficient operating record this contractor enjoys, here's the way to get it: Ask a Gulf engineer to recommend the right lubricant for each piece of equipment your are using. His recommendations are based on thorough training and practical experience in the field.

GULF

Gulf quality lubricants are quickly available to you through more than 1200 warehouses in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

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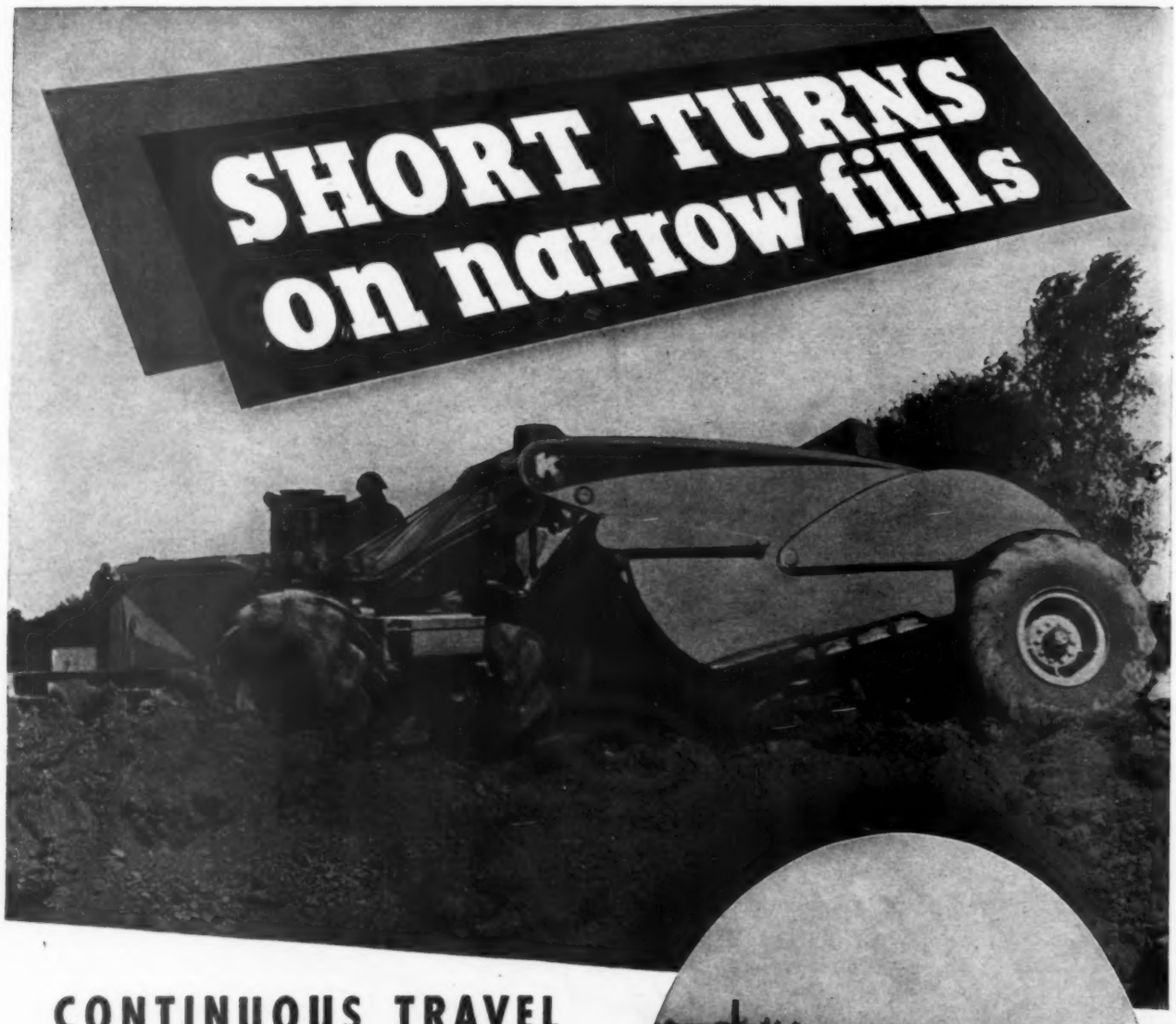


CONTINUOUS TRAVEL CUTS ROUND TRIP TIME

More loads per hour . . . speed in all operations . . . round trip time reduced to the minimum with Koehring Wheelers. Short turning radius, dumping at travel speed, dumping while turning, are important advantages to reduce round trip time. Koehring Wheelers turn in a 15 foot radius, operate on a 24 foot fill top, turn right or left at 90° or more. Either drive wheel can be locked by an independent brake to permit skid turning. Short wheel base between tractor drive wheels and trailing wheels is an important Koehring feature. Continuous travel when dumping and turning cuts round trip time . . . increases trips per hour . . . yardage per shift . . . speeds job to completion.

KOEHRING CO • ***Milwaukee, Wisconsin***

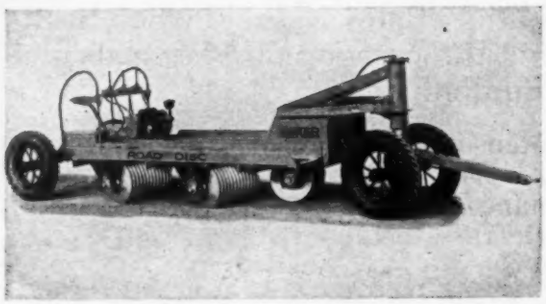
Short turning at travel speed permits quick return for next load. Koehring Wheeler turns either direction on narrow fills.

KOEHRING HEAVY DUTY

HEAVY-DUTY CONSTRUCTION EQUIPMENT

These Stabilized Soil Road Making Tools Speed Bituminous Road Maintenance, Too!

They're "two-timers", these Baker Road Building and Maintenance Tools



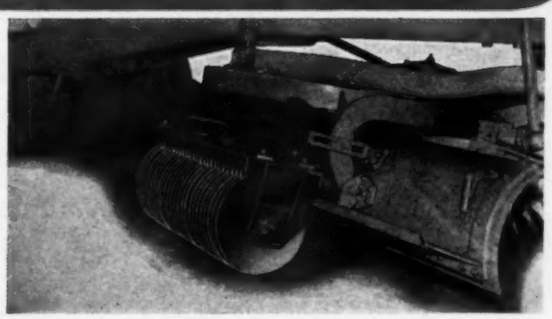
Baker Road Discs have hydraulic control—ride the discs high on dry or wet mixing for soil stabilization and on "black top" maintenance or dig them in, up to a half a foot to pulverize rooted roadbeds. Or cut deep on the crown side and shallow on the berm side—they're as flexible as a piece of chain.

Not a made-over farm implement—they're tough, heavy duty road machines. Alloy steel disc gangs adjustable to crown of road—discs can be spaced for 2", 4" or 6" centers. Roller bearings throughout. *They cut ice and packed snow, too, in the winter time.*

Baker Road Maintainers spread cement, calcium chloride or other binder in soil stabilization, level the mixed material to ready it for compacting, and they blade disked materials on bituminous roads preparatory to compacting. Do all jobs quickly and thoroughly. Hydraulic controlled blades, adjustable to conform to crown of road or ditches. Enables you to get more use from your tractor.

Get the complete facts on these cost-cutting, job simplifying, dual purpose Baker Road Machines, Discs, Maintainers, Rooters—send for Bulletin No. 834-M.

Baker Road Rooters were specifically designed for road work. Hand wheel adjustment. Digging controlled from tractor driver's seat. The rugged standards take hard top and old impacted road-beds in their stride. Wear resistant, replaceable teeth penetrate to a foot deep. They speed stabilized soil road construction and break up "bulges" and "flows" on "black top" roads.



Baker Disc Grader Attachments are readily mounted on the moldboard of patrol graders—swing out of the way when not in use. Depth of cut and work angle controlled by same mechanism that operates blade. Doubles the utility of any blade grader. Makes fine surface cuts on "black top" and oiled roads to take down corrugations and bulges. Speeds shoulder maintenance. Send for Bulletin No. 831.

THE BAKER MFG. CO.

506 Stanford Ave., Springfield, Illinois

BAKER *The Modern Tractor Equipment Line for*

EARTH MOVING
LEVELING AND GRADE BUILDING
SNOW REMOVAL
ROAD MAINTENANCE

UNIVERSAL
LORAIN

MOTO-CRANE*

IT TRAVELS! 240 MILES

IN 10 HOURS BETWEEN JOBS

That's how fast this owner† moved from one job to another with his Moto-Crane* traveling—

1. Under own power.
2. On 10 rubber-tired wheels.
3. Over state highways.
4. Whether it's 5 miles or a 240 mile move, the Moto-Crane* will travel to the job in a hurry—and on the job will give you the kind of performance listed below.

IT LIFTS!

850 TONS OF STEEL

ERECTED AT AN AVERAGE RATE OF 40 TONS PER DAY

This owner's† output was made possible by the Moto-Crane's*—

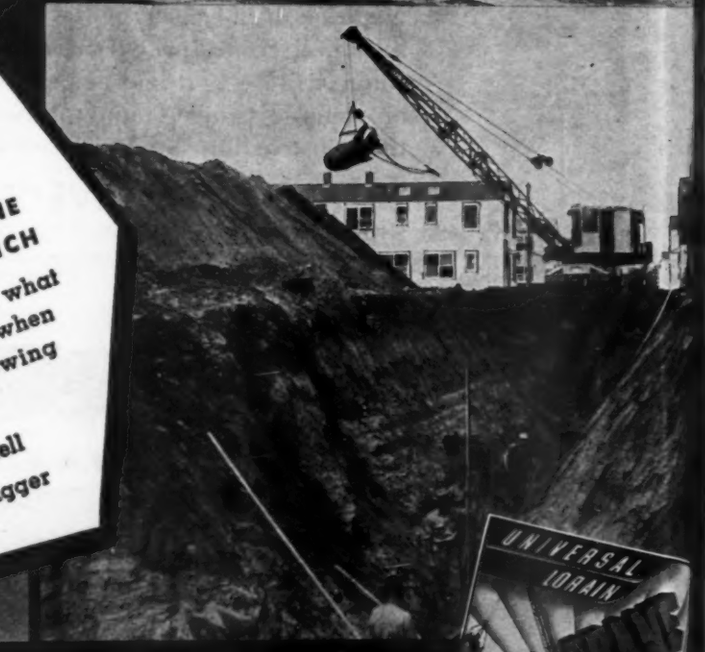
1. Maneuverability around the job.
2. Extensible booms (30 to 110 ft.)
3. Steel erector's precision boom hoist.
4. Balanced Center Drive turntable, which develops maximum capacities per pound of weight.

IT DIGS! 60 YDS. PER HOUR

OPERATING AS DRAGLINE TO DIG 17 FT. SEWER TRENCH

This owner's† results are typical of what you'll get with the Moto-Crane*, when equipped with any of the following interchangeable booms—

1. Dragline
2. Shovel
3. Clamshell
4. Backdigger



No job too small or short... No job too big or tough.

†Name on request.

*Reg. U. S. Pat. Off.

*Write for 24 page, illustrated catalog describing the mechanized Moto-Crane**

UNIVERSAL CRANE DIVISION • THE THEW SHOVEL COMPANY
LORAIN, OHIO

ROADS AND STREETS

January, 1942, Vol. 85, No. 1

Developments in Curve Design, Speed and Sight Distance

By CHARLES M. NOBLE

Chief Highway Engineer, War Department, Arlington, Virginia

THERE is a definite relationship between vertical curvature, and horizontal curvature and speed. Therefore, it is essential in establishing the design speed for a highway that sufficient sight distance be provided to accommodate the speed made available in the horizontal curves. It is hazardous if superelevation is provided of such magnitude in horizontal curves that the motorist will be induced and encouraged to travel at speeds appreciably above available sight distance. Consequently, it is necessary for the highway engineer to establish a reasonable balance between the sight distance which can be provided and superelevation design.

The definition of sight distance has been established generally during the past few years and broadly classified into two main divisions—passing sight distance and non-passing sight distance.

The determination of sight distance for safe passing operations involves several variables which makes precise evaluation difficult as well as controversial and furthermore involves highway economics to such an extent that the American Association of State Highway Officials has adopted the design policy of establishing "no passing zones" for two lane highways in difficult topography and passing zones in sections of the highway where the topography is such that passing sight distance may be obtained with economy. The magnitude of the passing problem on two lane highways may be visualized when it is noted that a passing sight distance of 13,000 feet, or nearly two and one-half miles, may be required for a highway with a design speed of 70 miles per hour when a 70 mile per hour vehicle must pass another traveling 65 miles per hour.

On the other hand, the determination of non-passing sight distance is susceptible of a comparatively simple analysis based on braking friction and human reaction time. For example, the distance required to bring a vehicle to a stop (see figure 1) at the design speed is determined and to this is added the distance traversed during the perception-reaction time period. At the moment, there appears to be a general tendency to assign a braking friction factor of $f = 0.40$ to determine stopping distances after the brakes are applied; and a time interval of two seconds to permit the operator to perceive conditions requiring a stop and to get his foot on the brake. Tests* conducted by General Motors Proving Ground indicate that a friction factor of $f = 0.3$ may be a more conservative and preferable value to use. These values of f apply to wet and dry pavements.

As a matter of fact there is evidence that more attention should be directed to the problem of providing additional sight distance in sections of the country subject to ice and snow inasmuch as the vehicle is more difficult to control when operating on ice particularly when a stop is required. The magnitude of this problem is indicated in figure 1.

The design assumptions for the deetermination of daylight and night time non-passing distance utilized in the design of the Pennsylvania Turnpike were covered in detail in the October, 1939, issue of ROADS AND STREETS and need not be repeated here. It is of interest to note, however, that the line of sight adopted, a height of eye of 4½ feet to a 4 inch

*Deceleration Distances for High Speed Vehicles—By E. E. Wilson, Proceedings Highway Research Board, 1940. Page 393.

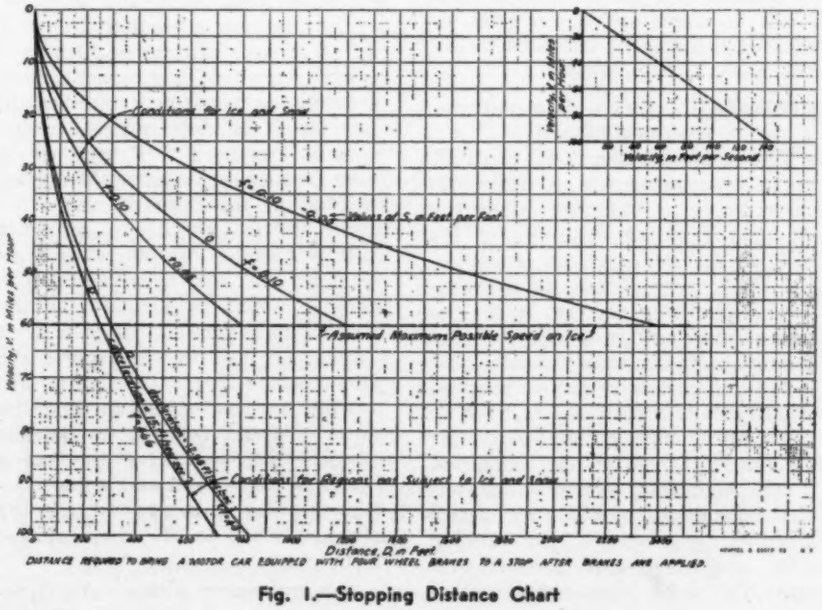


Fig. 1.—Stopping Distance Chart

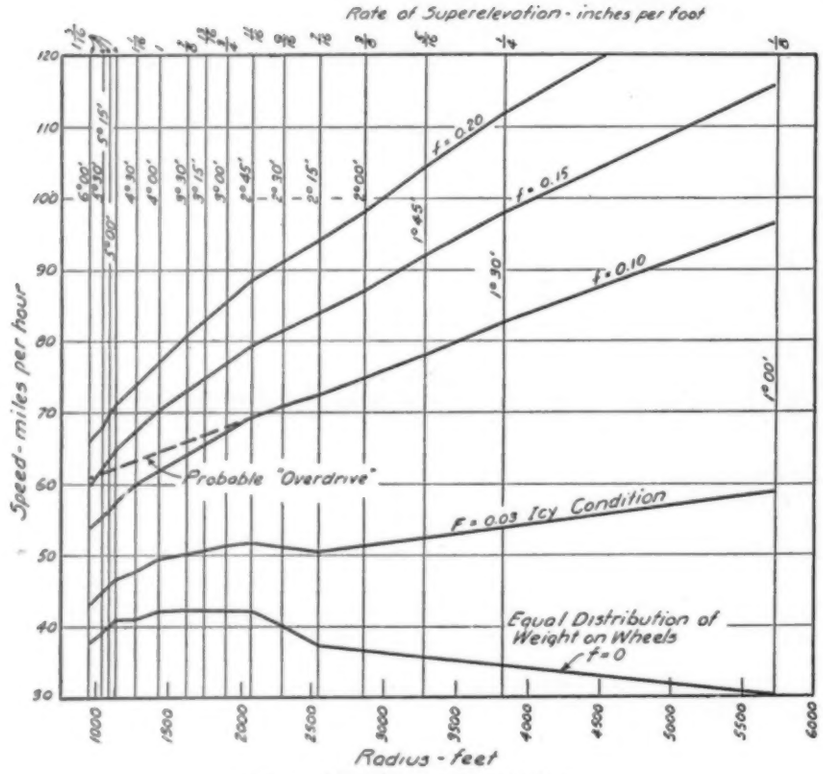


Fig. 2.—Superelevation Speed Chart

object, for daylight distance provides a car to sight (4½ feet to 6 feet) nearly twice as great over summit vertical curves but very little increase in sight where horizontal curvature sharper than 3 degrees is involved if cut slopes, trees or other obstructions occur along the inside of the curve. It is apparent therefore that horizontal curvature limits sight distance quite materially, particularly when combined with vertical curvature. If a realistic view of the effect of ice and snow on the sight distances problem is taken, it becomes evident that easier horizontal curves must be adopted if sufficient additional sight distance is to be provided.

Horizontal Curves, Superelevation and Speed

Two general conditions confront the highway engineer in horizontal curve design, (1) territory where the topography varies widely as in the case of the Pennsylvania Turnpike, and (2) territory where the topography is relatively uniform as in the case of the southern seaboard region and areas in the middle west.

In the first case it may be prohibitive in cost to construct a highway to a uniformly high design speed over extended distances. In the second case it may be entirely economical to construct a highway to a uniform design speed for distances of several hundred miles and the design speed may be quite high when compared to present road speeds. In the latter territory moderately sharp curvature may render a highway obsolete within a relatively few years.

Where the topography varies widely, the designer is faced with the dilemma of whether to design the entire route at a speed corresponding to the sharpest curves or to design the flat curves for high speed with considerable superelevation, attaining the maximum permissable at a degree of curve considerably below the sharpest curve. Either of these two courses introduces hazards to the motorist, for in the former method if sharp curvature were utilized in open easy topography where long tangents were prevalent, such sharp curvature would come as a complete surprise to the motorist and many accidents would result from failure to negotiate curves. In addition, the engineer who actually had the temerity to construct such a highway would be severely criticized by the motoring public, since it would be difficult for the motorist to assign any common sense reasons for utilizing a sharp curve where obviously easy curvature was feasible. In the second method the motorist would be induced, possibly subconsciously to drive the easier curves at high speed and would consequently be unprepared for the sharper curves in the more rugged topography.

The problem of widely varying topography faced the designers of the Pennsylvania Turnpike and a compromise solution was utilized in order to provide as uniform and consistent operating conditions as possible and so that the motorist would not be encouraged to operate at a speed materially above sight distance requirements. This method has been treated in detail elsewhere.* Briefly the method consists of designing the superelevation based on a "straight line" speed relation between the flat curves and the sharpest curves, as indicated in figure 2, arranging groups of curves in orderly sequence from flat to sharp and back to flat; and utilizing the easiest possible curves at the ends of tangents 6,000 feet or more in length. Although, the physical reasons were not understood at the time, the tendency was recognized that drivers run up higher friction values on more highly superelevated curves than on curves with relatively little superelevation, and it was felt that this phenomena should assist in providing uniformity in operating conditions. The tendency of drivers to "overdrive" curves sharper than 2 degs. 45 min. was forecast and sight distance and spiral lengths were provided, based on the "overdrive" speed curve shown in figure 2.

As previously mentioned, it has been observed that drivers of their own volition will generally develop higher friction values on highly superelevated curves than on curves with flat superelevation. It is believed that the cause of this phenomenon is found in the body roll of the vehicle and to the inherent sense of balance possessed by the average human being. For example, if a vehicle is operating on a curve with superelevation at 1-3/16 inches per foot, (0.10 ft. per ft., vertical angle of 5 deg. 43 min.) and traveling at such a speed and developing such a centrifugal ratio (cornering ratio) as to cause a body roll of 5 deg. 43 min., the horizontal plane of the body will be truly horizontal when referred to the horizon. On the other hand, if a vehicle is operating on a curve with a superelevation of ⅛ inch per foot (0.01 ft. per ft., vertical angle 0 deg., 35 min.) and traveling at such a speed and developing such a centrifugal ratio as to cause a body roll of 5 deg. 43 min., the horizontal plane of the body will be tipped over away from the curve center at an angle below a truly horizontal plane amounting to 5 deg. 8 min., (5 deg. 43 min. minus 0 deg. 35 min.). The body of the driver is correspondingly tipped over out of

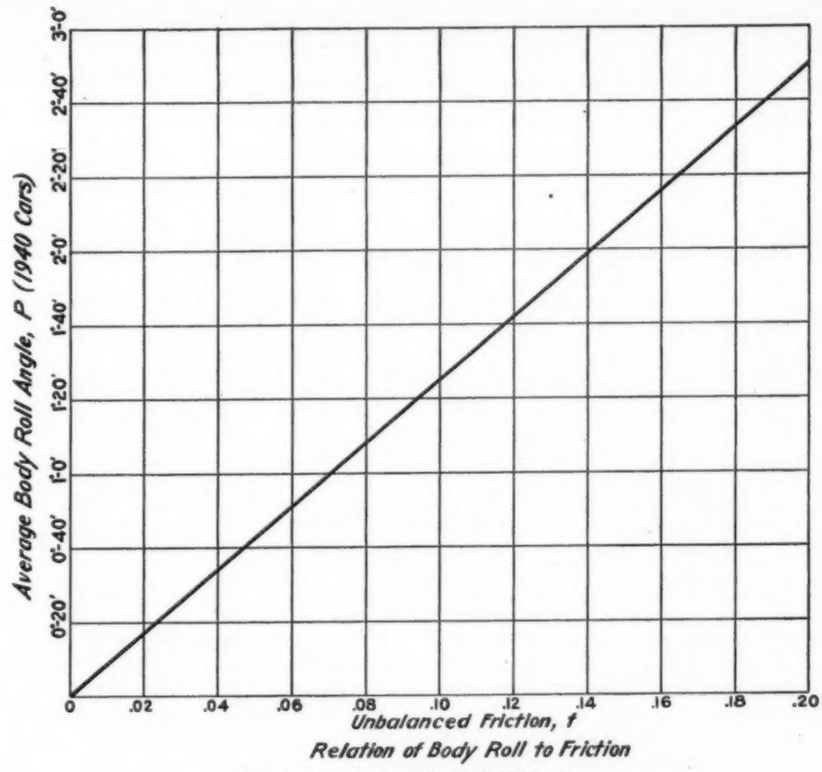
*Roads and Streets, October 1939. Civil Engineering, July 1940. Proceedings Highway Research Board, 1940, p. 429.

true verticality and the tilt creates a feeling of alarm, although the unbalanced centrifugal ratio is the same in both cases. This undoubtedly is the cause of the optical illusion that the pavement is superelevated in a reverse direction. In addition, the shift in the center of gravity of vehicle and driver may add to the sense of alarm. It is believed that the body roll factor provides on the Turnpike, without creating any hazards in operation, a restraining influence in preventing speeds materially above sight distance requirements.

The operating experience on the Pennsylvania Turnpike indicates that in spite of the widely varying range in curvature a remarkable uniformity in operating conditions has been achieved. It is believed that this uniformity is due to arranging the curves in sequence, designing superelevation so that the body roll on the flat curves restrains drivers from operating at speeds materially above available sight distance limitations, providing heavy superelevation on the sharp curves, the use of flat curves between long tangents and the use of spirals.

The average body roll for 1940 automobiles is shown in figure 3. An analysis of the body roll factor in the Turnpike design will further illustrate the restraining influence of flat superelevation on speed. Figure 4 shows the speed for which rear end collision (non-passing) sight distance was provided for the complete range of curvature; the rate of superelevation; the unbalanced coefficient of friction between tires and road surface (unbalanced centrifugal ratio) at the speed for which sight distance was provided; the body roll of vehicle corresponding to the centrifugal ratio; and the residue. By residue is meant the value obtained by subtracting the body roll from the superelevation. All values on the chart are given in feet per foot. The relationship of body roll to superelevation and speed is shown in figure 5 where the superelevation in feet per foot of width is denoted by *e* and the body roll converted into the equivalent slope in feet per foot, by *d*.

An examination of figure 4 reveals that on a 6 deg. curve at a speed of 60 m.p.h. a friction value of 0.15 is developed and a residue of 0.06 feet per foot is available, while on a 1 degree curve at a speed of 70 m.p.h. a friction value of only 0.05 is developed, and no residue remains, in fact the vehicle is tipped slightly over below a horizontal plane. Thus a large residue is available on the sharp curves when a fairly high friction value is utilized by the driver, whereas as the curves



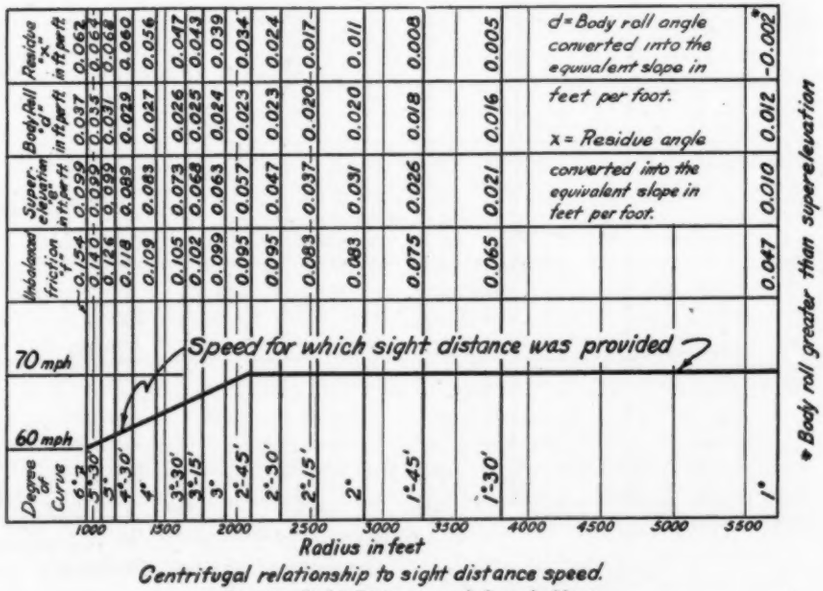
Relation of Body Roll to Friction

Fig. 3.—Average Body Roll 1940 Cars

become easier the residue is reduced, in fact requiring a reduction in speed and friction on the 1 deg. curves in order that a "negative residue" does not develop. In other words, the same friction between pavement and tires is available in the flat curves as in the sharp curves, but the driver is not comfortable when utilizing it and consequently is induced to keep the speed of the car down near the range of the sight distance provided. The strategy on the Turnpike was to provide a heavy residue on the sharp curves and to reduce the the residue as the curves became easier in order to restrain motorists from operating at speeds materially above that required by available sight distance. Additional superelevation in the flat curves would have encouraged the motorist to operate at higher speeds.

If a car is driven from one end of the Turnpike to the other at the speeds indicated on figure 4 a remarkable uniformity in "ride sensation" is experienced.

In territory where the topography



Centrifugal relationship to sight distance speed.

Fig. 4.—Sight Distance and Speed Chart

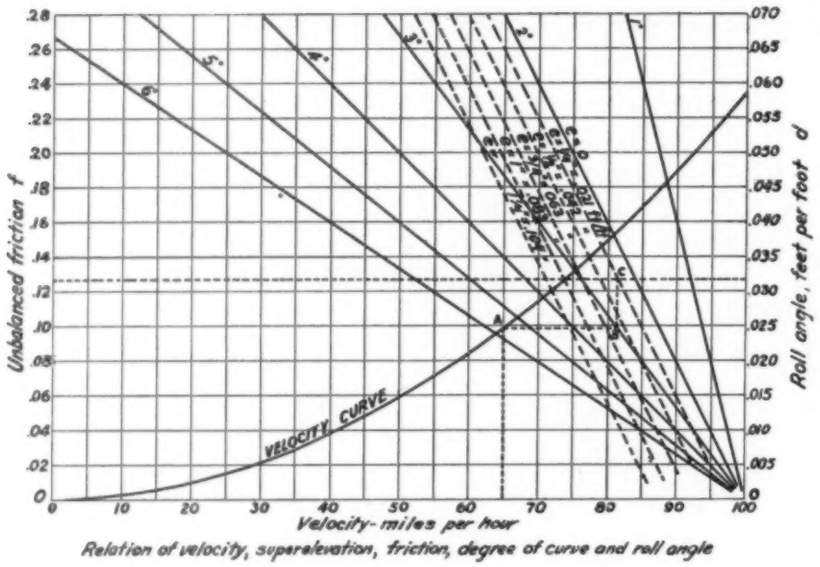


Fig. 5.—Relating Speed, Superelevation, Friction, Degree of Curve and Roll Angle

remains reasonably constant for relatively long distances, the problem is entirely different, in that a uniform design speed at a more constant friction value can be adopted and sight distance provided therefor. In uniformly rough country where *all* the curvature must of necessity be sharp, the indicated procedure is to utilize fairly high friction values and provide the motorist with a high residue. In such a procedure, widening and clearing to provide sight distance along the inside of curves must of necessity be resorted to. In easy country it is entirely feasible to utilize uniformly low friction factors, and low residues, designing the superelevation so that, at the design speed, the body roll of the vehicle will not exceed the rate of superelevation.

As previously stated the speed potentialities of the modern and future motor car make it necessary to enlarge design thinking in order that the highway may not be obsolete before it is completed. This is particularly true in the case of horizontal curvature and it has only been during the past few years that an attempt has been made in curve design to develop and utilize scientific data* relating to the physical forces involved, as well as taking into account the characteristics and behavior of vehicle and operator.** In this development there has been a tendency to utilize unbalanced friction (centrifugal ratio) values, that, in the writer's opinion, are unduly high and consequently not conservative. These assumptions and methods when applied to main line trunk highways have resulted in curvature of such sharpness that there is a grave probability that the continued development of the motor car will render the alignment obsolete in territories with relatively easy topography. A study of figure 7 (Sight Distance for Horizontal Curves) indicates that sharp curvature restricts sight distance on those curves which are in cuts or have trees or other obstructions on the inside of the curve. In addition, where high speed is concerned the radii of curves become so large that a superelevation problem, long known to railway engineers, arises due to the conflicting requirements of slow moving and fast traffic. In railway practice the problem is one of rail wear and has been met by adjusting the superelevation so that fast trains will wear the outer rail the same amount that slow trains wear the inner. In highway design the problem is not one of wear, but of safety, for while a railway is able to enforce a slow order on a curve such a procedure has not proven practicable with the American motoring public and if a flat curve is superelevated sufficiently for high speed operation, slower moving vehicles such as large trucking units may be in-

*Bulletin 120, Iowa State College.

**Curve Design and Tests on the Pennsylvania Turnpike," Highway Research Board, 1940.

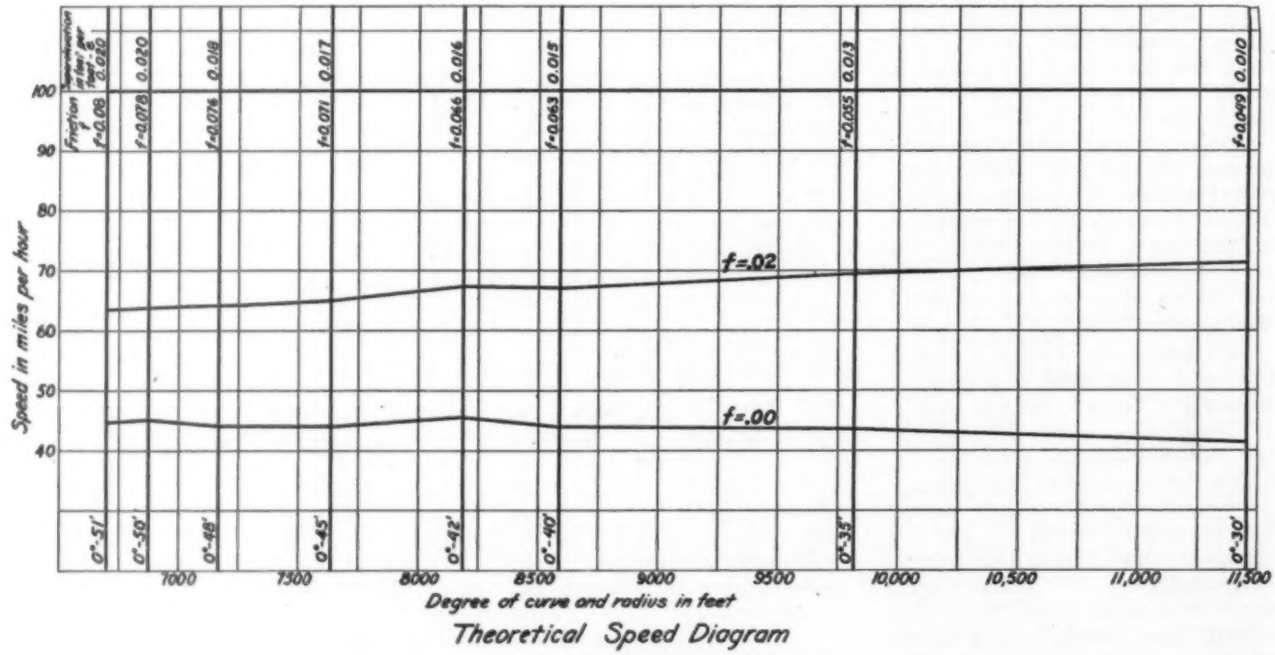


Fig. 6.—Theoretical Speed Chart

duced, unconsciously to "edge in," because of the forces of gravity, and crowd the inner lane possibly with disastrous results to other vehicles. This suggests that the radius of the sharpest permissible curve should be sufficiently expanded so that it is possible to utilize a very moderate maximum rate of superelevation. The high speed curve tests conducted on the Pennsylvania Turnpike led to the recommendation by the investigators that an unbalanced centrifugal ratio of $f = 0.10$ for speeds of 70 miles per hour and greater should not be exceeded and indicated that the body roll of the vehicle should not exceed the rate of superelevation at the design speed. Figure 3 shows the average body roll for 1940 model passenger automobiles and it will be noted that the body roll for 1940 models at $f = 0.10$ amounts to 1 deg. 25 min. which is equivalent to a superelevation of 0.025 feet per foot. In easy country it may be desired to reduce the superelevation to a maximum of ¼ inch per foot and in order to prevent the body roll from exceeding this amount it is necessary to reduce the value of f in order to reduce the body roll. A study of figure 3 indicates that a value of $f = .08$ will satisfactorily accomplish this result. With a design speed of 100 miles per hour, $f = 0.08$ and a maximum superelevation of ¼ inch per foot the theoretical speed diagram illustrated in figure 6 indicates the various operating conditions. The superelevation noted on the diagram has been designed without regard to practical considerations in order to illustrate the method. Practical requirements limit a change in superelevation to a minimum change of 1/16 inch per foot of width. It will be noted on the diagram that a value of $f = 0.02$ will provide a speed of more than 60 miles per hour, which is considered the maximum possible speed on ice and a speed of 45 miles per hour balances the forces on the sharpest curve with $f = 0.00$. With a superelevation as flat as ¼ inch per foot it is believed that heavy trucking units can actually travel slower than 45 miles per hour without being subjected to a pronounced tendency to edge in toward the inner lane. It may be noted that increasing f from 0.08 to 0.10 will theoretically reduce the minimum permissible radius from 6,700 feet to 5,600 feet at a superelevation of ¼ inch per foot, but the roll angle will exceed the superelevation.

A comparison of the minimum radius shown in figure 6 with the sight distance requirements indicated in figure 7 (Sight Distance for Horizontal Curves) indicates that a minimum radius of 6,700 feet falls somewhat short of providing adequate sight distance in cuts, etc., for icy conditions and it would therefore appear that the adoption of 6,700 feet as the minimum radius for express highways is fully justified in favorable topography. Stripped of all technicality, the whole matter boils down to the common sense principle that horizontal curvature should be as flat as possible. Sharp curvature has been responsible for, and one of the primary causes of, obsolescence in highways in the past and it is unthinkable that engineers should risk the possibility of modern express routes ever becoming obsolete, particularly from the cause of sharp curvature, in view of the tremendous sums which these highways will cost. This is especially true of toll projects where obsolescence would jeopardize the value of the bonds and result in a direct loss to investors.

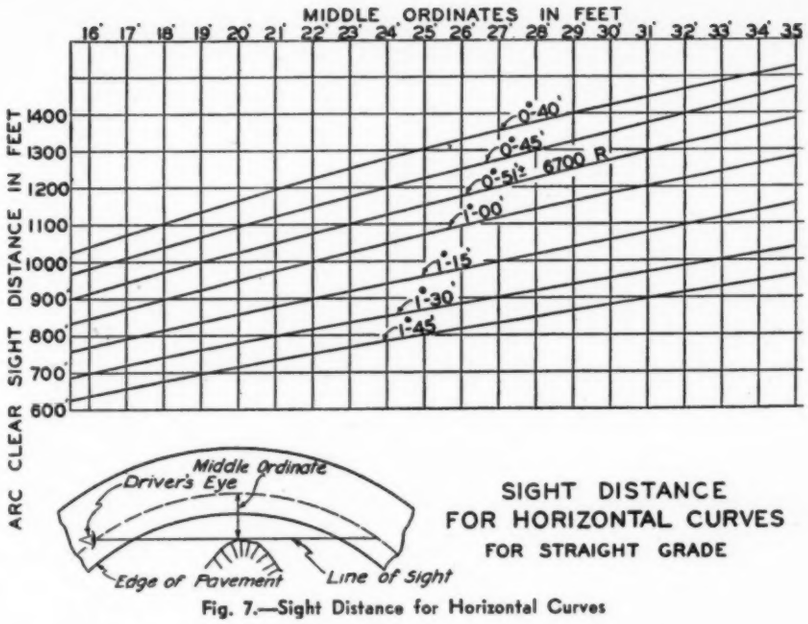


Fig. 7.—Sight Distance for Horizontal Curves

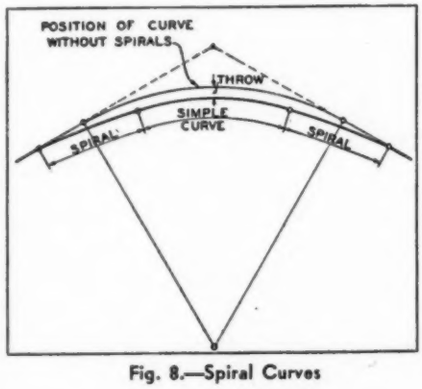


Fig. 8.—Spiral Curves

Spirals

The use of spiral curves in highway practice is with a few exceptions relatively new. The spiral in universal use was developed for railways and is based on the logical reasoning that the rate of spiral curvature should increase uniformly from zero to the degree of the simple curve, thus enabling the superelevation to increase in a straight line from zero to the maximum rate, so that the superelevation will exactly satisfy the requirements of the radius at every corresponding point. It also permits a uniform rate of change in centrifugal acceleration, provided the balancing effect of superelevation is neglected. The curve which satisfies these conditions is a cubic equation and all present spirals are of this form regardless of the methods of approximation which have been developed for field stakeout. Figure 8 illustrates the general principles involved in relation to the simple curve.

Two schools of thought have developed as to the method of determining the length of spiral, the rate of rotational change per unit of time to accomplish the maximum superelevation, and the rate of change of centrifugal acceleration (neglecting the balancing forces due to superelevation). The former method is generally used by the railways and their experience indicates a conservative rate of two per cent of cross slope per second of time at the assumed speed, while the latter was proposed by Royal-Dawson* and has been accepted by Moyer,** the Public Roads Administration, and various state highway departments.

*Royal Dawson, F. G.—Elements of Curve Design, Etc. (London 1932).
**Bulletin 120, Iowa Experiment Station, Ames, Iowa.

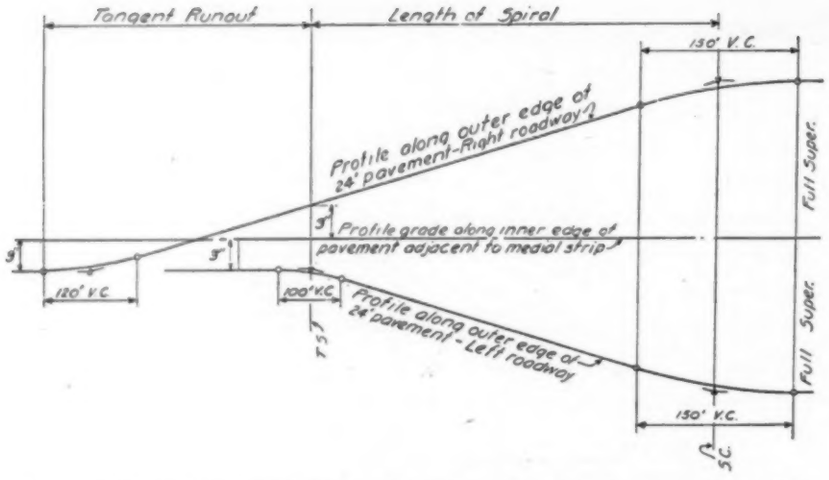


Fig. 9.—Method of Attaining Superelevation on Turnpike. Drawn for a curve to the left

Degree of Curve	Rate of Superelevation, in. per ft. of width	Length of Spiral	Tangent Runout
deg. min.		*ft.*	*ft.*
1 45	$\frac{1}{16}$	150	260
2 0	$\frac{2}{16}$	150	210
2 15	$\frac{3}{16}$	200	210
2 30	$\frac{4}{16}$	200	164
2 45	$\frac{5}{16}$	250	162
3 0	$\frac{6}{16}$	250	160
3 15	$\frac{7}{16}$	280	158
3 30	$\frac{8}{16}$	300	157
4 0	1	350	154
4 30	$1\frac{1}{16}$	370	148
5 0	$1\frac{2}{16}$	410	146
5 15	$1\frac{3}{16}$	400	145
5 30	$1\frac{3}{16}$	400	141

Note: No data are given for 6 deg. curves since special spiralization was required due to ruggedness of terrain. The superelevation on the upgrade roadway was at rate of 1 in. per ft. and on the down grade roadway $1\frac{3}{16}$ in. per ft.

TABLE I
Rate of Superelevation, Spirals and Tangent Runout

Moyer recommends a rate of change of centrifugal acceleration of two with a resulting formula of

$$L = \frac{1.58V^3}{R},$$

in which V equals the design speed in miles per hour and R equals the radius of the simple curve in feet.

So far as is known no one has questioned the validity of a cubic equation for highway use and this is due in all probability, to the fact that it is correct from a practical standpoint for railway conditions where the vehicle must accurately follow the spiralled path because of the rails and it may be correct for highway usage for curves sharper than four degrees.

In considering any feature of highway design it must be constantly remembered that highway operation is composed of two parts —the vehicle and the operator. The vehicle being "free wheeled" and the operator a free agent imposes the task of providing a curve with a locus which will fit the practical limitations of both and furnish a path conforming to the natural tendencies of vehicle and operator. When considering spirals for flat curves, the cubic equation provides a locus with a radii of almost infinity along the first third of its length and it would appear a practical impossibility for an operator to turn the wheel such an infinitely small amount. Casual observation also indicates that most operators utilize more "throw" than is provided by a cubic equation. An example will illustrate the two methods of determining spiral length and indicate the order of magnitude of the component parts of a spiral for a flat curve under the following assumptions:

Design speed, 100 m.p.h.

Radius of curve, 6,670 feet.

Rate of superelevation, 0.03 foot per foot of width.

Pavement slope on tangent, 0.01 foot per foot of width.

Utilizing the method of rotation at the rate of two per cent cross slope per second of time, a spiral 294 feet long will result, which for practical reasons would be rounded up to 300 feet. The "throw" for a 300-foot spiral amounts to 0.56 foot.

Utilizing the method of the rate of change of centrifugal acceleration with a rate of two feet per second, per second, a spiral 236 feet long will result, which for practical reasons would be rounded up to 240 feet. The "throw" for a 240-foot spiral amounts to 0.36 foot.

Considerable imagination is required to lead one to hope the car can be so delicately manipulated by a driver that a path can be so accurately followed in a distance of 300 feet that a "throw" of only 6¾ inches is attained, and yet if the path is not accurately followed the theory of the cubic equation breaks down. It is doubtful if a vehicle can be operated this accurately on a tangent in moderately windy weather. In a gusty wind a car traveling at 70 miles per hour and upwards is often moved laterally several feet in a distance less than 300 feet. It is therefore felt that more "throw" is required than indicated by a cubic equation.

Because of the unknown and controversial issues involved in the design of spiral curves the most logical procedure would be to conduct a series of accurately controlled and instrumental tests in order to establish natural travel paths selected by operators in entering curves and to discover what turning radius results from the slightest pressure on the steering wheel so that this detail of design can be established on a firm practical basis.

Attaining Superelevation

The use of spiral curves provides the only satisfactory means of attaining superelevation as has been pointed out by many authorities. The detailed method of providing superelevation runout varies among the various states and depends on width of roadway and method of rotation. It, therefore, may be of some interest to outline the method developed on the Pennsylvania Turnpike in order to indicate the order of magnitude of the runout.

Due to the narrow strip (10 feet) it was not practicable to rotate each 24-ft. roadway about its center line, and after considerable study, taking into account drainage, and conditions occasioned by melting snow, it was decided to hold the edges of the paved roadway nearest the center line of the Turnpike in the same plane at all times. In order to introduce superelevation it was necessary to elevate the outer edge of the righthand roadway and to depress the outer edge of the lefthand roadway for lefthand curves, and reverse the procedure for righthand curves. In the case of a curve to the right, the normal 3-in. crown of the righthand roadway provides a superelevation of ⅛ inch per foot in the

proper direction, whereas in the case of a lefthand curve, the normal crown provides a slope of ⅛ in. in a reverse direction. Because of the narrow width of the medial zone as well as a desire for uniformity in spiral length for each corresponding degree of curve, the spirals for each 24-ft. roadway were made the same length and the pavement provided with ⅛ in. superelevation in the proper direction at the beginning of the spiral. In the case of lefthand curves, this necessitated providing a tangent runout on the righthand 24-ft. roadway in order to warp the pavement up from a crown or bank sloping downward away from the center line at the rate of ⅛ in. per ft. to a bank of ⅛ in. per ft. sloping downward toward the center line of Turnpike. The method of attaining superelevation is illustrated in figure 9 and the length of the tangent runout for different degrees of curvature is given in Table I.

It was felt that the change in transverse slope on the tangent runout from ⅛ in. per ft. downward to ⅛ in. per ft. upward would cause no ill effects in vehicle operation. Operating experience indicates that it possibly has a favorable influence.

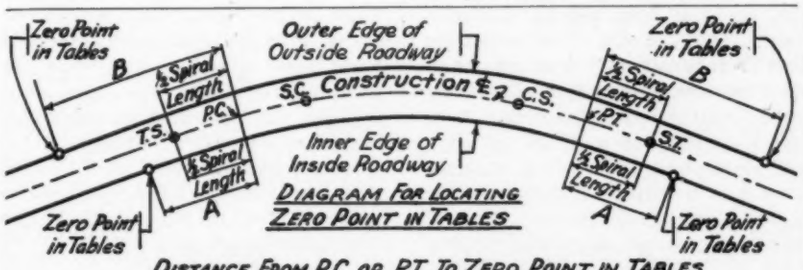
In order to assure that field stakeout would be accurately and uniformly done, tables were prepared showing ordinates above and below the profile grade for the entire portion of the superelevation runout for each degree of curve in use on the Turnpike. One of these tables is shown in Table II. In addition, where vertical curvature fell within the runout section, profiles were drawn along the edges of the pavement to a scale of 1 inch equals 10 feet horizontally and 1 inch equals 1 foot vertically and the runout adjusted slightly in order to eliminate unsightly sags or crests. This procedure, involving as it did a tremendous volume of work, nevertheless assured a pleasing appearance at no practical sacrifice in operating characteristics and the results in the completed work fully justifies the expenditure of the necessary time and effort.

In conclusion, it may be stated that the interrelationship of horizontal curvature, superelevation and sight distance is recognized generally today and that the design of these important highway elements has entered an era of scientific development not deemed practical a decade ago.

TABLE II

2°—30′ CURVE — SPIRAL LENGTH—200′
SUPERELEVATION—9/16 IN./FT. — RUNOUT LENGTH—164′

Inner Edge of Inside Roadway				Outer Edge of Outside Roadway			
Distance From Zero Point		Ordinate Below ∫ Grade Ft. & Decimals	Ordinate Below ∫ Grade Ft. & Inches	Distance From Zero Point		Ordinate Above or Below ∫ Grade Ft. & Decimals	Ordinate Above or Below ∫ Grade Ft. & Inches
0′	↑	— 0.250	— 0′—3″	0′	↑	— 0.250	— 0′—3″
10′	|	— 0.252	— 0′—3″	10′	|	— 0.248	— 0′—3″
20′	|	— 0.259	— 0′—3 1/16″	20′	|	— 0.242	— 0′—2 15/16″
30′	|	— 0.270	— 0′—3 1/4″	30′	|	— 0.233	— 0′—2-13/16″
40′	|	— 0.285	— 0′—3-7/16″	40′	|	— 0.220	— 0′—2 11/16″
50′	|	— 0.305	— 0′—3-11/16″	50′	|	— 0.203	— 0′—2-7/16″
60′	|	— 0.329	— 0′—3-15/16″	60′	|	— 0.182	— 0′—2-3/16″
70′	|	— 0.358	— 0′—4-5/16″	70′	|	— 0.158	— 0′—1 7/8″
80′	|	— 0.390	— 0′—4-11/16″	80′	|	— 0.130	— 0′—1-9/16″
90′	↓	— 0.427	— 0′—5 1/8″	90′	↓	— 0.097	— 0′—1-3/16″
100′		— 0.469	— 0′—5 5/8″	100′		— 0.061	— 0′—0 3/4″
125′		— 0.578	— 0′—6-15/16″	110′		— 0.022	— 0′—0 1/4″
150′		— 0.688	— 0′—8 1/4″	120′		+ 0.021	+ 0′—0 1/4″
175′		— 0.797	— 0′—9-9/16″	125′		+ 0.044	+ 0′—0 1/2″
180′	↑	— 0.819	— 0′—9-13/16″	150′		+ 0.157	+ 0′—1 7/8″
190′	|	— 0.860	— 0′—10-5/16″	175′		+ 0.270	+ 0′—3 1/4″
200′	|	— 0.897	— 0′—10 3/4″	200′		+ 0.383	+ 0′—4 5/8″
210′	|	— 0.932	— 0′—11-3/16″	225′		+ 0.496	+ 0′—5-15/16″
220′	|	— 0.964	— 0′—11-9/16″	250′		+ 0.609	+ 0′—7-5/16″
230′	|	— 0.994	— 0′—11-15/16″	275′		+ 0.722	+ 0′—8-11/16″
240′	|	— 1.019	— 1′—0 1/4″	289′		+ 0.786	+ 0′—9-7/16″
250′	|	— 1.043	— 1′—0 1/2″	290′		+ 0.790	+ 0′—9 1/2″
260′	|	— 1.063	— 1′—0 3/4″	300′	↑	+ 0.834	+ 0′—10″
270′	|	— 1.081	— 1′—1″	310′	|	+ 0.874	+ 0′—10 1/2″
280′	|	— 1.095	— 1′—1 1/8″	320′	|	+ 0.912	+ 0′—10-15/16″
290′	|	— 1.107	— 1′—1-5/16″	330′	|	+ 0.946	+ 0′—11 3/8″
300′	|	— 1.116	— 1′—1 3/8″	340′	|	+ 0.977	+ 0′—11 3/4″
310′	|	— 1.122	— 1′—1-7/16″	350′	|	+ 1.006	+ 1′—0-1/16″
320′	|	— 1.125	— 1′—1 1/2″	360′	|	+ 1.031	+ 1′—0 3/8″
325′	↓	— 1.125	— 1′—1 1/2″	364′	|	+ 1.040	+ 1′—0 1/2″
				370′	|	+ 1.053	+ 1′—0 5/8″
				380′	|	+ 1.073	+ 1′—0 7/8″
				390′	|	+ 1.089	+ 1′—1-1/16″
				400′	|	+ 1.102	+ 1′—1 1/4″
				410′	|	+ 1.112	+ 1′—1-5/16″
				420′	|	+ 1.120	+ 1′—1-7/16″
				430′	|	+ 1.124	+ 1′—1 1/2″
				439′	↓	+ 1.125	+ 1′—1 1/2″



DISTANCE FROM P.C. OR P.T. TO ZERO POINT IN TABLES

DEGREE OF CURVE	A	B
1°-45′	125′	335′
2°-00′	125′	285′
2°-15′	150′	310′
2°-30′	150′	264′
2°-45′	175′	287′
3°-00′	175′	285′
3°-15′	190′	298′

TABLE II
Ordinates for Attaining Superelevation for Use on Field Stakeout

268 Cities Adopt 18,000 Lb. Working Stress for Structural Steel

The American Institute of Steel Construction has just issued a pamphlet entitled "Adoptions of the A.I.S.C. Standard Specification" which notes that 268 cities and 14 governmental bodies have adopted or permit the use of the specification incorporating an allowable basic working stress for structural steel for buildings of 18,000 lb. per square inch. In addition, 429 cities and 20 public bodies, to effect a more economical and efficient use of structural steel, have adopted or permit the use of the 20,000 lb. per square inch basic stress specification in their codes.

▼

$20,000,000 *Appropriation for Inter-American Highway.*—President Roosevelt on Dec. 26 signed legislation authorizing an appropriation of $20,000,000 for United States cooperation with Central American governments in construction of the Inter-American highway.

Machine Spreading, Tamping and Finishing Hot Tar Mix on City Street

Construction With Road Tar During 1941

By GEORGE E. MARTIN
Consulting Engineer, Paving Material Sales, The Barrett Division, Allied Chemical and Dye Corporation

BESET with priorities and crude tar scarcity on the one hand and by an increased demand because of defense construction on the other, the lot of the road tar distiller has not been exactly a happy one in 1941. Because of these conditions comparatively few changes have been made either in road tars or the methods of using them. It is true also that the road tar industry is a stable one and radical changes are not to be expected either now or in the immediate future. Gradual changes, of course, are always taking place.

Tar Specifications

Road tar specifications are becoming more nearly standardized each year. New Federal Board specifications were issued during 1941. The two national specification writing bodies, the American Society for Testing Materials and the American Association of State Highway Officials, have been eliminating minor differences in their road tar specifications by joint action of their respective committees. All of these specifications now use the range of consistency grades from RT-1 to RT-2 and these grades are being adopted by an increasing number of state highway departments and other road tar users.

A sulfonation test to detect and control the admixture of asphaltic materials with certain road tars has been adopted by several state highway departments and probably will be adopted by others in the near future. While the test is a measure of the presence of asphaltic material, a high sulfonation factor within the limits given below does not necessarily indicate that such materials have been added to the road tar. Certain crude tars especially water gas and vertical retort tars may have comparatively high sulfonation factors as normally produced. Up to this time the test has been confined to grades RT-1 to RT-6. The values commonly used are as follows:

Grade Sulfonation Factor; Max.	RT-1	RT-2	RT-3	RT-4	RT-5	RT-6
Total dist. to 300°C.	8	7	6	6	5	5
Distillate 300-355°C.	1.5	1.5	1.5	1.5	1.5	1.5

The sulfonation factor is defined as the per cent of sulfonation residue in the distillate multiplied by the per cent of distillate.

In some specifications a sulfonation factor of 1.0 has been used for the distillate from 300 to 355°C. It is the opinion of the writer that that value is unduly restrictive and excludes road tars which are entirely satisfactory. Many highway officials hold the same view.

The sulfonation factor is not a measure of quality of itself within the limits given above. In other words a road tar with a sulfonation factor near the lower limit is not for that reason better than a road tar with a sulfonation factor near the upper limit.

Construction Specifications

During 1941 representatives of various companies in the road tar industry and various highway officials cooperated in the preparation of specifications for the construction of paving types using tar. The following discussion presents a brief outline of these specifications.

HOT-LAY TAR CONCRETE PAVEMENT TWO-COURSE CONSTRUCTION

The material used consists of broken stone or slag coated with hot tar binder. The binder course is approximately 1½ inches thick and the top course from ½ to ¾ of an inch thick.

The grading of the aggregate is as follows:

	Binder Course Percent	Top Course Percent
Passing 1½ inch sieve	100	
Passing 1 inch sieve	70–100	
Passing ½ inch sieve	20–60	100
Passing ⅜ inch sieve	–	85–100
Passing No. 4 sieve	5–20	55–80
Passing No. 8 sieve	0–5	35–65
Passing No. 40 sieve	–	14–34
Passing No. 100 sieve	–	6–20
Passing No. 200 sieve	–	5–15

Proportions are as follows:

	Binder Course		Top Course	
	Stone	Slag	Stone	Slag
Tar Cement, % by weight	3.0– 5.0	4.0– 6.0	6.5– 8.5	7.5–10.0
Mineral Aggregate, % by weight	95.0–97.0	94.0–96.0	91.5–93.5	90.0–92.5

The tar used is grade RT-11 or RT-12 which is heated to 175 degs. F. to 250 degs. F. for mixing.

The aggregate is heated to between 150 degs. F. and 225 degs. F.

HOT-LAY TAR CONCRETE ONE COURSE CONSTRUCTION

The specifications are the same as for the two course construction with the following exceptions:

Proportions:

	Surface Course	
	Stone	Slag
Tar Cement, percent by weight	6.0–8.0	7.0–9.0
Mineral Aggregate, percent by weight	92.0–94.0	91.0-93.0

Grading of Aggregate:

	Surface Course Percent
Passing 1 inch sieve	100
Passing ¾ inch sieve	85–100
Passing ⅜ inch sieve	60–85
Passing No. 4 sieve	40–70
Passing No. 8 sieve	25–55
Passing No. 40 sieve	10–25
Passing No. 100 sieve	5–15
Passing No. 200 sieve	0–8

A hot tar seal coat of 0.15 to 0.30 gallon per square yard with fine aggregate cover is required.

COLD-LAY TAR CONCRETE TWO COURSE CONSTRUCTION

The requirements are the same as for the Hot Tar Concrete construction with the following exceptions:

Proportions:

	Binder Course		Top Course	
	Stone	Slag	Stone	Slag
Tar Binder, % by wt.	3.0–5.0	4.0–6.0	6.0–8.5	7.0–10.0
Mineral aggregate, % by wt.	95.0–97.0	94.0–96.0	91.5–94.0	90.0–93.0

Grading of Aggregate:

	Binder Course Percent	Top Course Percent
Passing 1½ inch sieve	100	–
Passing 1 inch sieve	70–100	–
Passing ½ inch sieve	20–60	100
Passing ⅜ inch sieve	–	85–100
Passing No. 4 sieve	5–20	40–75
Passing No. 8 sieve	0–5	25–55
Passing No. 20 sieve	–	15–35
Passing No. 200 sieve	–	0–8

The tar used is grade RT-8, RT-9 or RT-10 heated to a temperature of 150 degs. to 250 degs. F. The lowest workable temperature is to be used.

The aggregate is heated to between 100 degs. F. and 135 degs. F.

A hot tar seal coat grade RT-9 or RT-10 is required when the aggregate grading of the top course falls below the middle of the limits given. 0.15 to 0.25 gallon per square yard is required covered with fine aggregate.

DENSE-GRADED TAR PLANT-MIX

This type is comparable to road mixes and is not intended to replace the more closely controlled Tar Concrete Pavements.

Proportions:

	Binder Course	Top Course
Tar Binder, percent by weight	3.0–5.0	5.0–7.5
Mineral Aggregate, percent by weight	95.0–97.0	92.5–95.0

Grading of Aggregate:

	Percent by Weight Passing Sieve Openings					
	Two Course Wearing Surface			One Course Wearing Surface		
Sieve Size	Binder Course	A	B	C	D	E
1½ inch	100					
1¼ inch	–			100		
1 inch	70–100			90–100	100	
¾ inch	–			–	85–100	100
½ inch	20–60	100	100	65–85	–	80–100
⅜ inch	–	80–100	85–100	–	60–85	–
No. 4	5–20	40–75	55–80	35–65	40–70	45–75
No. 8	0–5	25–55	40–65	20–50	25–55	30–60
No. 200	–	0–8	5–15	0–8	2–10	3–12

Tar Binder—Grades RT-7 to 12.

Tar Seal—Grades RT-7 to RT-10 applied at the rate of 0.2 to 0.35 gallon per square yard covered with fine aggregate.

TAR PENETRATION MACADAM PAVEMENT

Coarse Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing
2½ in.	100
2 in.	90–100
1½ in.	35–70
1 in.	0–15
½ in.	0–5

Intermediate Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing
½ in.	100
⅜ in.	85–100
No. 4	10–30
No. 8	0–10

Fine Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing
⅜ in.	100
No. 4	85–100
No. 8	10–40
No. 16	0–10

Tar Binder—Grade RT-12.

Tar Seal—Grade RT-10.

Construction procedure:

1. Spread coarse aggregate to sufficient depth to provide a 2½ inch depth after consolidation.

2. Roll with three-wheel ten-ton roller.

3. Apply tar binder at rate of 1.5 to 1.6 gallons per square yard.

4. Fill surface voids with intermediate aggregate 25 to 35 pounds per square yard.

5. Sweep and roll.

6. Apply tar binder at rate of 0.6 to 0.7 gallon per square yard.

7. Cover with 15 to 25 pounds of fine aggregate per square yard.

8. Sweep and roll.

9. Apply tar seal at the rate of 0.3 to 0.4 gallon per square yard.

10. Cover with 20 to 30 pounds of intermediate aggregate per square yard. Airports use fine aggregate.

11. Sweep and roll.

SAND-TAR ROAD-MIX

In this construction the tar binder is mixed with the existing or modified sand on the road or airport.

The tar used is Grade RT-6, RT-7 or RT-8. From 0.3 to 0.6 gallon per square yard per inch of compacted thickness will be required. Tar is applied in increments of approximately 0.35 gallon per square yard.

Mixing may be done by road-mix methods or by means of a traveling mixing plant.

Roadmixing tar and sand, using common farm disc

Consolidating mixture with sheep-foot roller

Rolling hot tar concrete with old model steam roller on a city street

Testing density of tar stabilized base

Coarse Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing
1½ in.	100
1 in.	90–100
¾ in.	40–75
½ in.	15–35
⅜ in.	0–15
No. 4	0–5

Fine Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing	
	⅜ in. to No. 8	No. 4 to No. 16
½ in.	100	
⅜ in.	85–100	100
No. 4	10–30	85–100
No. 8	0–10	10–40
No. 16		0–10

Tar grades:

Tar Prime—Grade RT-2 or 3.

Tar Binder—Grade RT-8 or 9 in summer months and RT-6 or 7 in early spring or late fall.

Tar Seal—RT-7, 8, or 9.

Construction procedure:

1. Spread coarse aggregate to a loose depth of 2½ inches.

2. Apply tar binder at the rate of 0.8 to 0.9 gallon per square yard. Increase 25 per cent for slag aggregate.

3. Mix.

4. Spread and level and roll.

5. Fill surface voids with 15 to 25 pounds of fine aggregate per sq. yd.

6. Sweep and roll.

7. Apply tar binder at the rate of 0.3 to 0.4 gallon per square yard.

8. Cover with 10 to 12 pounds of fine aggregate per square yard.

9. Sweep and roll.

Spreading tar for a surface treatment

Finished surface; tar surface treatment

10. Apply tar seal at the rate of 0.2 to 0.3 gallon per square yard.

11. Cover with 10 to 15 pounds of fine aggregate per square yard.

12. Sweep and roll.

A mixing plant may be used to coat the aggregate with the tar binder thus eliminating steps 2 and 3.

TAR ROAD-MIX GRADED-AGGREGATE TYPE

This construction consists of a layer of graded aggregate mixed with tar, spread and rolled, and sealed with tar and fine aggregate.

Grading of Coarse Aggregate:

Sieve Size (square openings)	Total Percent Passing
1 in.	100
No. 4	40–75
No. 200	0–10

Grading of Fine Aggregate:

Sieve Size (square openings)	Total Percent Passing	
	⅜ in. to No. 8	No. 4 to No. 16
½ in.	100	–
⅜ in.	85–100	100
No. 4	10–30	85–100
No. 8	0–10	10–40
No. 16		0–10

For airport surfacing No. 4 to No. 16 size aggregate or coarse sand must be used.

Grades of Tar:

Tar Prime—Grade RT-2 or 3.

Tar Binder—Grade RT-5, or 6 in early spring and late fall, and RT-6, 7, or 8 in summer months.

Tar Seal—Grade 7, 8 or 9.

Quantity of Tar Binder for Mixing:

	Gallon per square yard
2 in. loose depth.....	0.8–1.0
2½ in. loose depth.....	1.0–1.2
3 in. loose depth.....	1.2–1.4

Construction procedure:

1. Apply tar prime to the stone or gravel base at the rate of 0.1 to 0.2 gallon per square yard.

2. Coarse aggregate is spread to the loose depth specified.

3. Apply tar binder at the rate of 0.4 to 0.6 gallon per square yard.

4. Mix.

5. Repeat until the required amount of tar binder has been applied and mixed.

6. Spread and roll.

7. Apply tar seal coat at the rate of 0.2 to 0.3 gallon per square yard.

8. Cover with a light application of fine aggregate, sweep and roll. A traveling plant may be used to mix the tar and aggregate.

TAR DOUBLE SURFACE TREATMENT

This construction consists of an application of prime coat tar, followed by an application of hot tar, covered with coarse aggregate and rolled.

Coarse Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing
1 in.	100
¾ in.	90–100
⅜ in.	35–65
No. 4	5–25
No. 8	0–5

Fine Aggregate Grading:

Sieve Size (square openings)	Total Percent Passing	
	⅜ in. to No. 8	No. 4 to No. 16
½ in.	100	
⅜ in.	85–100	100
No. 4	10–30	85–100
No. 8	0–10	10–40
No. 16		0–10

Grades of tar:

Tar Prime—Grade RT-2 or 3.

Hot Tar—Grade RT-9, 10, or 11.

Tar Seal—Grade RT-6, RT-9, 10, or 11.

Construction procedure:

1. Apply tar prime at the rate of ¼ to ½ gallon per square yard.

2. Allow time for tar prime to penetrate into the road surface.

3. Apply hot tar at the rate of 1/3 to ½ gallon per square yard.

4. Cover with 30 to 45 pounds of coarse aggregate per square yard.

5. Sweep and roll.

6. A seal coat of .2 to .3 gallon of tar seal per square yard may be applied at the end of thirty to sixty days.

7. Cover with 15 to 25 pounds of fine aggregate per square yard.

8. Sweep and roll.

Tar Stabilized Base Course

This construction consists of natural soil, plus an aggregate admixture if required, loosened, pulverized and mixed with tar and with water when specified. The mixture is thoroughly compacted and given a tar tack coat.

Tar grades RT-3 to RT-6 are used in this work depending upon local conditions.

The amount of tar required in the mixing depends upon local conditions but will usually run from ¼ to ½ gallon per square yard per inch of consolidated depth.

Construction procedure:

1. Scarify the existing material to the required depth.
2. Add aggregate if required.
3. Add water if required.
4. Pulverize until there are no soil lumps larger than ½ inch.
5. Apply tar in increments of ½ to ¾ gallon per square yard until the specified amount has been applied.
6. Mix.
7. Compact with sheep-foot roller followed by pneumatic-tire roller.
8. Level with blade or drag and finish consolidation with flat wheel roller.
9. Apply tack coat of tar at the rate of 0.2 to 0.3 gallon per square yard. A light sand cover may be used.

A traveling plant may be substituted for the road-mix methods described.

Conclusion

Although there have been no great changes in 1941, there has been gradual progress in the standardization of the road tar material and in the way it is used in the construction and maintenance of roads, airports, and other paved areas.

Mixing tar and sand for airport runway with portable bituminous mixing plant. Chute extension discards over-run on sand, which is not much

A.G.C. Convention Transferred to Indianapolis

The 23rd annual convention of The Associated General Contractors of America will be held at Indianapolis, Indiana, Feb. 16, 17, and 18, 1942, instead of at Seattle, Washington, as originally scheduled.

The principal business of the coming convention will be to:

1. Develop a more complete program for meeting construction needs of the nation during the war period.
2. Develop further means by which the general contracting industry, through the national association and the 90-odd chapters and branches, can cooperate with government agencies for war and essential civilian construction and civilian protection.
3. Develop further a program for immediate use of general contractors throughout the country, large and small, in these construction programs.
4. Bring to contractors latest and most complete information which can be given on all problems relating to their business.
5. Explore problems relating to the future of the contract system of construction.

Because of the war, the convention will be cut from the usual four to three days. The general outline will be to hold the opening session Monday afternoon, Feb. 16; meetings of the Building, Highway, and Heavy Construction and Railroad Contractors divisions on Tuesday; and general sessions all day Wednesday, concluding with the annual dinner.

After outbreak of hostilities in the Pacific, officers of the national association and the host chapters at Seattle conferred and agreed that no attempt should be made to hold the present convention there, although the Seattle and Mountain Pacific chapters were completing plans for it. The chapters requested that instead, if possible, the 1943 convention be held in Seattle.

Thereupon the A.G.C. chapters in Indiana, who previously had sought to have the convention in Indianapolis, agreed to be hosts. The host chapters, and officers, therefore, will be:

Indiana General Contractors Association—President, William E. Mohler; Executive Secretary, C. Oliver Holmes.

Indiana Highway Constructors, Inc.—President, Robert H. King; Executive Secretary, W. H. Holland.

The Claypool Hotel will be convention headquarters.

28th Annual Michigan Highway Conference

The 28th Annual Michigan Highway Conference will be held at the University of Michigan, Ann Arbor, Mich., Feb. 18 to 20, 1942.

The morning of Feb. 18 will be devoted primarily to discussions of the relation of highways to war and post-war conditions, two of the speakers being Mr. Charles M. Upham, Executive Director of the American Road Builders' Association, and Highway Commissioner G. Donald Kennedy of Michigan. At noon, there will be a luncheon at which President Ruthven will be the principal speaker. The theme of the afternoon session will be recent developments in methods of construction and maintenance of highways. The evening session will be a smoker, at which Mr. Glenn C. Richards, who was recently appointed Chairman of the Detroit Defense Council, will discuss conditions as he observed them on a recent trip to London, England.

The Thursday morning session will have special reference to traffic engineering and highway safety, among the speakers being O. K. Normann of the U. S. Public Roads Administration, Mr. Sidney J. Williams of the National Safety Council, and Mr. Maxwell Halsey, formerly Associate Director of the Yale Bureau for Traffic Research.

On Thursday afternoon there will be three simultaneous sessions, one on traffic control, one for State Highway Department engineers, and one for County commissioners and engineers. The Annual Banquet will be held Thursday evening.

All the advantages of turnpike construction can be obtained by proper foundation control and surface treatment under favorable conditions. Plant-mix surface can be added later as needed

Important Developments in Asphaltic Surfacings

By **BERNARD E. GRAY**
Chief Engineer, The Asphalt Institute

NOT since the inception of our highway program has a problem of such magnitude confronted the engineers of this country as faces it now. We do not yet realize the extent of this problem, because the public has become so accustomed to free movement over the highways of America that they take roads and streets for granted. They do not see the great army of men and machines which is constantly at work, not only to build additions to the system, but merely to maintain road surfaces in their existing condition. It is of course possible to defer maintenance for a short time, and every one of us who is experienced in maintenance procedure knows exactly where such deferment can be made without it immediately becoming apparent to the public. But we also know that deferment for any long period of time is exceedingly dangerous, and that the transition from a highway system in good condition to the reverse can take place almost overnight when restriction of maintenance reaches a certain degree.

Comment is necessary on this phase of work, because unfortunately, there is a lack of understanding of this need for maintenance and betterment on the part of many high public officials, who are assuming that because the system appears to be in good condition today, it will be in the same condition six months from now even if no further appropriations are made. There are, however, ways in which savings can be made and current technique modified which will preserve the utility of the highways and yet reduce transportation requirements in importation of materials which may be needed in other kinds of work. As one aspect of such saving, emphasis should be placed upon utilization of aggregates and materials which involve either smaller volume or short haul rather than materials which require extensive rail or truck movement.

"Engineered" Subgrades"

In January, 1940 issue of "Roads and Streets," the writer referred to the item of "Engineered Subgrades." This word "engineered" is used to contrast the old hit-and-miss method of preparing the existing soil prior to placing a pavement with an efficiently designed method. Intensive study of soils and their behavior has resulted in a great advance in the technique of this "engineering" of subgrades. A definite procedure has been established to measure the load bearing characteristics of such foundations and the reactions of pavements placed upon them. The Asphalt Institute, for example, has carried on such work for several years which has been reported in Research Series Nos. 7 and 8.

It is indeed fortunate that in this period when utilization of local materials is so important that knowledge in regard to their use is available. This advance in soil science and the ability to construct soil-aggregate bases with rather exact knowledge as to their behavior, is the outstanding development of the present era. We have been accustomed to speak of stabilized soils and stabilized bases in rather loose terms, which have included a wide variety of procedures. However, the true employment of the term, and certainly the one to be considered most carefully at present, is mechanical stabilization which involves proper proportioning of the different sizes of aggregates to produce a layer of maximum density, which is practically immune to volume change under variable moisture and temperature conditions.

There are but few places in the United States where local aggregate of some sort is not available. In the areas where the great industrial work will be carried on, gravel, sand, stone and slag are found almost everywhere. Where the local gravel deposits are abundant and well graded, it is frequently possible to utilize them for foundations without addition of

any other aggregate. For example in New Hampshire, foundations of this character 18 in. in depth have been placed for as little as 20 cents per square yard. However, if aggregates are not well graded or are non-uniform, it will definitely pay to screen them to appropriate size and recombine to produce the maximum density condition. Frequently, the silt and clay washed from stone or gravel at commercial plants may be utilized as the binder in the recombined and reproportioned coarser sizes.

All of the various equipment utilized for paving mixtures may be economically employed for the construction of these mechanically stabilized bases, such as the transit-mixer and the various types of pug and drum mixers. Foundations so proportioned, and from 8 to 18 inches in thickness, are very strong and can be constructed to provide a bearing power of well over 100 lb. per square inch. Hence, consideration in the design of foundations should first be given to the practicability of employing some form of *mechanically stabilized* subgrade.

In areas where local aggregate may be scarce or where commercial aggregates are in great demand for other defense work, the construction of a stabilized sub-base employing *commercial* admixtures becomes desirable, because of ability to construct a somewhat lesser thickness and yet be certain of waterproofing and binding qualities. Two grades of asphaltic products are used for such work; emulsified asphalt and medium-curing cut-back asphalts. The technique of doing such work has been greatly improved in recent years as fundamental principles involved have been carefully studied. The use of the several types of travel plant or the stationary plant for pre-mixing of aggregates and asphalt has made for a more accurate moisture control.

This item of moisture control has been the cause of most of the trouble experienced in commercial admixture soil stabilization. With single blade-mixing methods, there was always a tendency to use too much water in order to facilitate mixing and spreading. However, if intermittent rainfall occurred during the work, or if work was done late in the year at low temperatures, it was difficult to remove the surplus water and consequently the mixture did not set up as intended. Incidentally, it has been found in all soil stabilization work that it is much better to modify heavy clay soils with granular materials than to add the additional commercial binder required to take care of the definitely larger surface area involved with small particles. Furthermore, the granular material facilitates mixing and evaporation of the water, thus providing for densification of the mixture in a short period of time.

Base Construction

From the foregoing, it is evident that the more nearly the subgrade is "engineered" for high bearing power under the most adverse weather conditions, the less the thickness of pavement that will be required. A bearing power of 100 lb. per sq. inch is easily obtainable. The largest trucks have a load not exceeding 20,000 lb. on one axle, and with dual tires, this means a load per square inch of less than 100 lb. On airports, the load under the largest bomber is something under 75 lb. per sq. in. Thus it will be seen that well built subgrades are able in themselves to carry all loads and that the surfacing problem is one of preserving this inherent strength by waterproofing and providing necessary resistance to abrasion.

In many instances, this might require only a surface treatment, except that as a factor of safety, there is a certain minimum thickness which has been found desirable to take care of isolated areas in the foundations which may settle. Nevertheless, under actual experience, such stabilized foundations have carried the heaviest loads with surface treatment alone where traffic was on balloon tires.

In asphalt types of pavement, a composite structure is the usual rule, which includes the "engineered subgrade," a binder course and a wearing course. This binder course is not necessarily the one thought of in connection with sheet asphalt paving, but is a transition course between the foundation and the wearing course. It is made of a coarser mixture and is cheaper in cost than the surface. It has the ability to move slightly, absorbing strains within itself without reflecting them through to the surface from the subgrade. Binder courses may be either plant-mix, macadam aggregate road-mix, travel plant-mix, or penetration macadam. In areas where high quality stone is available, penetration macadam bases 3 in. thick with 1½ gallons of hot asphalt binder are much to be desired. The heavy films of asphalt permit movement under frost action with complete rehealing in warm weather. Records in New England states in the east, and Oregon on the west coast, bear out the economy and durability of this type of construction.

There is an increased use of plant-mix bases and binder courses, as costs have steadily declined with betterment of equipment and automatic controls. More comment on this aspect of equipment later. The important thing in regard to use of asphaltic concrete for base construction is that aggregates often may be used, which are too soft for surface wear but yet are structurally strong when protected from abrasion. Certain soft sandstones for example, when coated with asphalt, become tough and hard even though when uncoated they may have a very high per cent of wear. Thus local aggregate in areas where hard aggregates are scarce, often is suitable for base construction, and only a small amount of imported aggregate is required for the wearing course. Considerable work in this regard has been done in recent years by the State Highway Department of Kentucky.

Surfaces
General Considerations

Asphalt mixtures are steadily increasing in use due to lower cost and improved surface characteristics. These lower costs have come about because of improved mechanical equipment, the letting of work in

Congested roads may be widened for future facility of traffic movement

Canada paves full roadbed width with hot-mix asphaltic concrete

Boulevard type of hot penetration macadam in Rhode Island

Typical blade grader preparing road-mix type with gravel and cut-back asphalt

larger contracts so that the overhead per unit of production has been much reduced, and finally, the utilization of a wide variety of aggregates not formerly permitted under old specifications. However, in this period of growing use, some confusion displays itself in regard to certain details, and it is believed that the reason for these misunderstandings lies in failure to hold to certain simple fundamental principles.

It should be obvious that the object in building a road is to obtain a durable, smooth-riding surface, and not to justify a particular aggregate, piece of equipment, or commercial binder. If, as a result of research, it is found that a new aggregate, when properly prepared, proportioned and blended, will produce a surface having the desirable properties, it is just as suitable as any previously employed product. Likewise, if a piece of construction equipment will proportion and mix constituents to the desired blend, then it is entirely suitable for the purpose, even though a new principle appears to be involved. In other words, it is not the method of doing the work that is the criterion of quality BUT RATHER THE END PRODUCT which is produced.

A number of advances have been made in recent years which definitely indicate some changes in this regard, and The Asphalt Institute is rewriting all specifications with view to including these changes which have resulted from aggregate and equipment studies. There is, of course, some lag between new developments and their complete adoption, but it is felt that wherever improvements are made which lead to lower costs, use of such knowledge should be made available to the public by appropriate change in specifications at the earliest possible date.

Applying hot asphalt cement at rate of 2 gal. per sq. yd., 20-foot width, for penetration macadam

Recommendations made several years ago to use softer asphalt cements have been proven sound by subsequent experience. In the surfacing of airports, the use of 120-150 penetration asphalt in coarse graded asphaltic concrete has shown up as completely satisfactory under all weather conditions from Maine to Florida and from the East Coast to the West Coast. For fine graded aggregate mixtures such as sand-asphalt, 85-100 penetration asphalt has proven satisfactory in contrast with the hard asphalts formerly employed. For average road and street construction, the 85-100 penetration asphalt is recommended for coarse graded asphaltic concrete, with 60-70 or 70-85 penetration employed under extremely heavy duty conditions. There would appear to be few hot-mix pavement locations today where an asphalt cement harder than 60 penetration is either required or desirable. Asphalt block surfaces often are to be recommended for unusually heavy duty locations, such as steep grades in cities and loading areas of terminals.

In the differentiation between the coarse graded mixtures and fine graded mixtures, it is to be remembered that in the former, stability is obtained by interlocking of the aggregate, and that the softest asphalt cement should be used consistent with a minimum stability. In practically any well proportioned coarse graded aggregate mixture, stabilities of 3000 lb. up are easily obtained. In sand mixes such as sheet asphalt or sand-asphalt, stability is more dependent on proportioning and the penetration of the asphalt cement is a little more important. However, the trend is steadily toward the use of softer binder and even for a street like Fifth Avenue, New York City, 60-70 penetration is sufficiently hard, while on rural roads 85-100 often may be employed, dependent on the character of the sand itself.

It should be emphasized that the choice of asphalt cement and the proper proportioning of the aggregate are the result of easy laboratory study and that such study always should be made. In looking over work throughout the country, particularly on many new defense projects, it has been a curious thing that laboratory control has often been overlooked. This may be due to the relative ease with which asphalt types are constructed, nevertheless there is necessity for careful laboratory control, and as in every other form of engineering work, such control produces the highest quality and uniformity.

Specific Surface Types

Several improvements have been made in the last year, and for the sake of brevity and emphasis, trends in each asphalt type will be commented upon briefly. Steps have been taken to utilize the research of other groups. For example, The Asphalt Institute has accepted Simplified Practice Recommendation R163-39 of the National Bureau of Standards in regard to sizes for aggregates, and will incorporate them in its new specifications. Careful study has been made of this recommendation and it is suggested to all aggregate users that these Simplified Practice gradings be adopted.

Surface Treatment.—Surface treatment as a pavement in itself still constitutes the wearing course on over 64,000 miles of state highways, while in percentage a much larger proportion of county and town roads are so surfaced. Originally, surface treatment was thought of as the first step in stage construction, but the balloon tire has made it useful for a much heavier volume of traffic than first contemplated, particularly where a high support foundation has been constructed. Very often a surface treatment which has shown incipient failure on base courses of 6 in. in thickness may give completely satisfactory service on bases 8 or 10 in. in depth. This additional thickness costs less than a single surface retreatment, and the economy resulting from attention to this critical base depth, dependent on local conditions, is apparent.

One improvement in technique is

the pretreatment of aggregate to insure retention on the surface of the road. It is a curious thing, but nevertheless a fact, that the dust in an aggregate will reach the surface of the road before the coarser particles during the application of cover, whether by hand or mechanical spreading. The trend in surface treatment has been to use heavier asphaltic products in all work except for very light seal coats. Where the dust hits the surface first, there is a toughening of the heavy asphalt film so that the wetting action is reduced and the aggregate tends only to be indented and not bonded to the surface of the road. This of course results in "whipping" of a certain percentage of the aggregate under fast-moving traffic, which largely can be prevented through pretreating with No. 2 fuel oil or MC-O cut-back asphalt.

The method of pretreatment is simple and has been utilized by several highway departments. An annular ring of pipe (bent to approximately 3 ft. in diameter) is perforated with small holes and connected to a tank which is under air pressure. The aggregate when unloaded from car or stock pile to truck by usual conveyor equipment, falls through this annular ring and receives a coating in the form of a fine mist spray. The amount required will vary from ¾ of a gallon per cubic yard on non-absorptive aggregates such as trap rock, to 1½ gallons for soft limestone. The procedure is simple, the retention of the aggregate on the surface of the road is definitely assured, with consequent uniformity of surface texture and the cost is less than the loss of untreated aggregate.

The color of an asphalt road may be made as light or as dark as desired by means of surface treatment procedure and it is becoming the practice on airports, for example, to finish all types of asphalt surfaces with a light seal coat employing a sand size cover. This size aggregate is also desirable because there are no flying particles which will do damage to a plane. Incidentally, the use of this small size aggregate for highway maintenance often will lead to a considerable saving in costs. Frequently, a road requires no additional structural strength, merely waterproofing, and 0.10 to 0.15 gallon with sand size aggregate will be just as satisfactory as twice the volume of asphaltic material with coarser aggregates. There is still reluctance on the part of some engineers to follow such procedure, because of the old feeling in regard to non-skid surfaces still remaining from the days of solid and cord tire traffic. However, it can be stated definitely that balloon tires tend to roughen the pavement rather than to smooth it out, and that the fine size aggregate will as a rule be entirely satisfactory.

For maintenance of plant-mix surfaces, there is a growing use of seal coat surface treatment as a definite method of periodic maintenance, particularly on highways and airports. The mix is designed on the lean side with a view to producing a rather dry pavement. At intervals of five or six years, approximately 0.2 gallon per sq. yd. treatments of either emulsified asphalt or cut-back asphalt are given and covered with aggregate all of which passes No. 4 sieve. Such procedure continually renews the surface texture, heals all small cracks, and adds years of useful life to the whole pavement structure.

Road-Mixes.—This type constitutes a large mileage of state and county highways and often is a second step in stage construction. Possibly the macadam aggregate type is utilized somewhat less than formerly, as plant-mix surfaces have tended to replace it in many of the eastern states. The dense graded type which employs gravel is widely used in the glacial areas of the northeast and the northwest. Mechanical mixers of various types are increasingly used because of more rapid mixing and ability to use heavier asphaltic products. However, all of the conventional methods of blade graders and multiple blade drags are as useful as ever, particularly for short length work.

Penetration Macadam.—Methods in this type are unchanged except in seal coat. Where basalt type of rocks are available, it is one of the most durable of pavements, the only drawback being some difficulty in producing a smooth riding surface because of the large stone employed. As a base such unevenness is of no consequence, but as a wearing course improvements in providing a fine texture have been adopted. In place of the 0.4 gallon per sq. yd. seal coat using the hot asphalt binder, a double application with liquid asphaltic products, such as rapid-curing cut-back asphalt or emulsified asphalt, is employed. The aggregate on these treatments may be dragged and the surface thereby brought to the desired condition of smoothness.

First step in widening and crown reduction is placement of wedge strips of plant-mix along the edges; immediately usable

Cold-Laid Mixes. — The trend is steadily toward the use of hot mixtures as cost has decreased and ability to haul a considerable distance from a stationary plant has become possible. High speed trucks permit such haul up to as much as 50 miles, and consequently, even with cold-laid types, there is a tendency to modify their make-up so that essentially they are becoming hot-mixes and are laid as such. However, there are many situations where the ability to place a surface cold is of great value as cold-laid mixes can be utilized in somewhat thinner section than is the case with hot mixes, due to the ability to "feather out."

Hot Plant-Mixes. — The trend is steadily toward the greater use of coarse-graded-aggregate types. They are cheaper because the aggregate has a lesser surface area and a smaller amount of asphalt is required for binder. They are easier to handle because coarse graded mixtures cascade somewhat better in advance of screed in mechanical finishing than do fine-graded aggregates. The item of cheapness is important because it means that a greater thickness of surface can be laid for the same money as

Typical travel plant preparing road-mix type of dense-graded aggregate at an Army air base

Setting steel forms for widening with asphaltic concrete. One side already resurfaced and under traffic

Use of light colored sand in surface treatment produces light surface on this Rhode Island highway

compared with past years. Frequently, there is a misunderstanding of just what a coarse-graded mixture is, and the thought sometimes prevails that "coarse graded" means "open graded" or "porous" mixes. The coarse-graded-aggregate mixture can be made just as dense as any other type by proper attention to gradation and the filling of voids in the coarse particles with successively finer sizes of aggregate and sometimes filler. Another advantage of the coarse-graded-aggregate mixture is the wider size variation which can occur without being critical in respect to final compaction.

Perhaps a brief comment in regard to some difficulties experienced in the past year with mechanical spreaders may be helpful. On several occasions, particularly with sheet asphalt mixtures, complaint was had in regard to surfaces which were too smooth, or where there appeared to be an excess of asphalt. When specifications were first written for hot plant mixtures, hand spreading was the only method available. Temperatures, therefore, were set at from 300 to 350 degrees, largely with view to having a sufficient period of time to permit hand shoveling and hand raking, and still have the mixture at a temperature which provided for proper compaction before cooling. With mechanical spreading, only seconds are required in comparison with minutes formerly needed. Consequently, if the mixture is laid at 300 to 350 degrees, it will be practically at that temperature after spreading through a mechanical finisher. The asphalt may be so hot that under finishing procedure there may be migration of binder from the lower portion of the pavement to the upper, thereby producing a greater per cent of asphalt than is required.

The remedy for this situation is so simple that it is a wonder it was not earlier discovered; viz., dropping the temperature of the mixture 50 degs. or even more, according to local conditions. From the mixing standpoint, temperatures over 300 degs. are rarely required and consequently this ability of the mechanical spreader to handle at 50 degs. F. lower temperatures is highly desirable, as it reduces heating costs and yet at the same time provides all needed flexibility in the mixture during finishing. New Institute specifications will call for 225 degs. F. plus where mechanical spreading is employed as contrasted with 300 to 350 degs. formerly required.

Another item that experience has demonstrated to be unnecessary is the control formerly inserted in respect to air temperatures at which pavement can be laid. Hot asphaltic concrete is undoubtedly the easiest of all pavements to lay at low temperatures. The great Naval Base at Quonset, Rhode Island, which was paved during the winter of 1940 and 1941, with temperatures running down close to zero, is an instance of how easily asphaltic concrete can be laid under most severe temperature conditions.

Applying cover aggregate with chip spreader —some hand brooming. This photograph was taken during construction of an airport

Light colored runway surface produced by light colored sand size aggregate on cutback asphalt seal application

With hand raking the period of time between spreading and rolling was so long in cold weather that proper densification was often difficult. With machine spreading, however, densification is obtained almost immediately and by having the roller follow immediately after spreading, densification is obtained before the mixture has opportunity to cool below the proper densification temperature. Inasmuch as there is no curing required for hot asphaltic pavement, it is in exactly the same condition as under summer work so long as the required density is obtained. Cutting samples from the pavement at periodic intervals will indicate whether or not this densification is being secured, and if so, every confidence can be had as to the immediate and continuous utilization of the pavement no matter at what temperature it has been constructed. New specifications, therefore, will eliminate the old limitation in respect to air temperatures at which work can be done.

Salvage

The need for conserving present values in pavements must be apparent to all. Likewise the need for minimum requirements in respect to transportation of all materials is evident. From observation of pavement behavior, it appears that the chief cause of bottle-necks, is restraint in respect to lateral movement of traffic. This restraint takes a number of individual forms, but all of them produce the same condition; viz., a long line of cars held up by a slow-moving vehicle with no opportunity to pass. Frequently, a two-lane pavement appears inadequate, when it is not so much the fact that it is a two-lane pavement, as it is that the lanes themselves are of inadequate width. Time and again, a highway with an 18 or 20 foot pavement which is congested at numerous points will be entirely satisfactory when it has been widened to 24 feet. In other words, 4 to 6 feet of additional pavement width will often produce the fluidity of movement of traffic which at first appears to be only cared for by a full additional lane or even two additional lanes. Hence, we find the widening operation one often to be considered, rather than entire reconstruction of the highway.

Where multiple lanes are very definitely needed, as in locations where high peak traffic is encountered, proper facilities often can be provided by new methods increasingly employed. In one instance, the existing road can be left as it is, but made a one-way highway. A new road can be constructed relatively parallel to it,

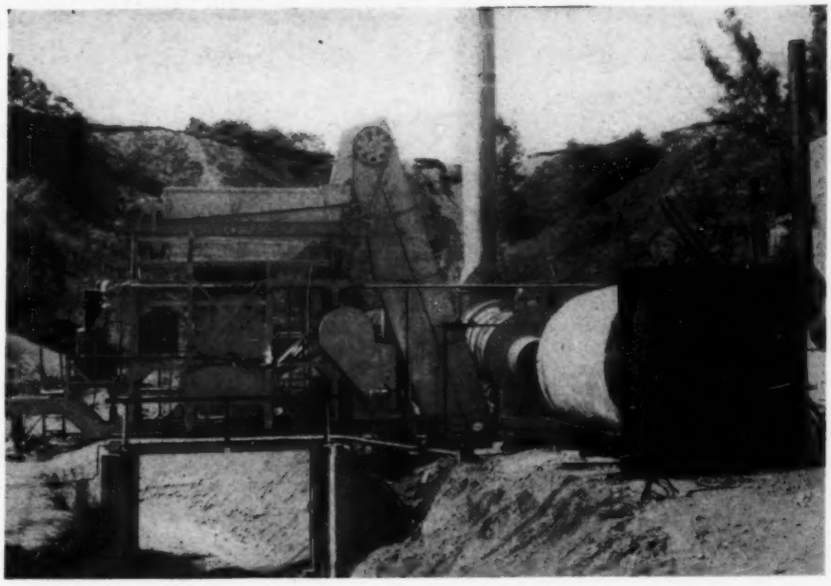
which likewise is a one-way road. Obtaining right-of-way for this additional road frequently will be much less difficult than for the reconstruction of the existing road to accommodate a four-lane pavement. Furthermore, the present road is usable during the construction of the new two-lane highway. Attention should be given to this possibility in many instances both because of lesser expense and least traffic interference during period of improevement.

Second, the construction of new arterial highways is not so much a pavement problem as it is provision for lateral movement. Our knowledge of subgrades and foundations is such that often all of the necessary traffic support can be secured by utilizing immediately available materials. In other words, the advantages of so-called "turnpike" construction often can be obtained with a surface treatment or a low-cost wearing surface, on four-lane or boulevard widths, and yet at minimum cost of time and materials. This is particularly an item to be considered adjacent to many of the industrial defense plants where traffic is made up almost entirely of passenger vehicles carrying workers,

Stabilizing a Florida sand soil mixture with cutback asphalt using a Jaeger Roadbuilder traveling plant

and where in many instances the two-lane road has become congested beyond belief. Attention should be directed to evaluating just what are the requirements for each particular road in respect to load, and designing the surface accordingly, instead of arbitrarily laying down a heavy duty pattern for all multiple lane situations.

Placing hot-mix asphaltic concrete surface course over penetration macadam base for air base aprons, parking strips and runways



Portable plant set up of the Cedar Rapids hot mix plant owned by Edwin Sabin, Jamaica, N.Y.

Summary

Reviewing trends in asphalt pavement design for the past year, the following are most important:

(1) The outstanding development is the technique which has been developed in respect to "engineered subgrades" whereby all of the required bearing power for traffic may be obtained by intelligent utilization of soil-aggregate combinations.

(2) The ability to utilize a great variety of aggregates in plant-mix construction which formerly were not permitted under the specifications.

(3) Pre-treatment of cover-coat aggregates for surface treatment work, whereby heavy asphaltic products may be utilized which will set up almost immediately and yet retain cover aggregate with minimum loss.

(4) Continued trend toward the use of plant-mixes as a result of improved equipment and lower overhead.

(5) Lower temperatures at which mixtures are placed, made possible by mechanical finishing, which has an influence on heating and drying costs, as well as the placement of the finished pavement.

(6) The need for salvage of every existing highway value and the maintenance of surfaces to the same excellence as under normal conditions.

(7) New, wider road surfaces can be obtained rapidly and at low cost by intelligently applying principles of "engineered" subgrades.

New Highway Group to Convene

The Southeastern State Highway Officials, organized last summer through the cooperation of V. J. Brown, Publishing Director of this magazine, plan to have their winter meeting at the Grove Park Inn, Asheville, North Carolina, on February 12 and 13, 1942. Following is a list of the first directors appointed:

The officers elected at the organizational meeting as published in the July issue are:

W. Vance Baise, Chief Engineer, North Carolina State Highway and Public Works Commission—President; Chris J. Sherlock, Director, Alabama State Highway Department — Vice President; and B. W. Davis, Maintenance Engineer, North Carolina State Highway and Public Works Commission—Secretary-Treasurer.

State	Name of Director	Title	Address
Alabama	W. G. Pruett	Office Engineer	Montgomery
Florida	J. H. Dowling	State Highway Engineer	Tallahassee
	L. P. Cannon (Alt.)	Asst. State Highway Engr.	Tallahassee
Georgia	M. L. Shadburn	State Highway Engineer	Atlanta
Kentucky	T. H. Cutler	State Highway Engineer	Frankfort
Mississippi	E. D. Kenna	Director, S. H. Dept.	Jackson
North Carolina	L. B. Prince	Chairman, SH & PWC	Raleigh
South Carolina	J. S. Williamson	Chief Highway Commissioner	Columbia
Tennessee	J. W. Gentry	State Highway Engineer	Nashville
Virginia	C. S. Mullen	Chief Engineer	Richmond
West Virginia	E. L. Bailey	Commissioner	Charleston

DIRECTORS FROM PUBLIC ROADS ADMINISTRATION

Dist. No. 8	Chas. D. Snead	District Engineer	Montgomery, Ala.
Dist. No. 14	N. S. Anderson	District Engineer	Spartanburg, S. C.

Two 34-E pavers rushing construction of an access road at an army post. Concrete was deposited and spread in two layers—about 60% by the first mixer and 40% by the second. The best day's run was 4742 sq. yd. of 9-7-9 section laid in 9½ hours

Trends in Concrete Highway Work in 1941

By

PROFESSOR A. DIEFENDORF

Head of Department of Civil Engineering
University of Utah, Salt Lake City, Utah

DEVELOPMENTS in the use of materials, and portland cement in particular, occur gradually over an extended period of time. To try to pick out certain particular things is practically impossible. A few changes and improvements may be noted at this time but may not be classed as having been developed entirely during 1941. Standardization of the portland cement product is regulated, not only by the association but by A.S.T.M., Federal, and State tests as well. Hence changes must occur slowly only after they have been tried and proven.

Testing

A few significant changes made in cement testing have been made by the A.S.T.M. The tension test of portland cement is now an alternative test. This test is supplanted by the cube compression test. The determination of fineness of portland cement is now to be made with the turbidimeter rather than with the sieve analysis. This is necessary because cement is being ground too fine to be measured properly by the finest sieve manufactured.

Portland cement is classified in five types:

Type I: For use in general concrete construction when the special properties specified for types II, III, IV and V are not required.

Type II: For use in general concrete construction exposed to moderate sulfate action or where moderate heat of hydration is required.

Type III: For use when high early strength is required.

Type IV: For use when a low heat of hydration is required.

Type V: For use when high sulfate resistance is required.

Cements conforming to the requirements for type IV and type V are not usually carried in stock. In advance of specifying their use purchasers should determine whether these types are, or can be made available.

In lieu of the steam apparatus the autoclave expansion test is recommended. This is a more severe test since the steam is under pressure and the control more positive.

Strength Design

Another trend in specifications is that of specifying strength in concrete mixture design as contrasted with that of specifying mixes. If the contractor is not equipped technically or otherwise to design his own mix, the owners laboratory will supply the needed information. This is a sensible move since it is the end toward which we are striving. The A.A.S.H.O. have this clause suggested as an alternate. The method was employed in Texas on U. S. 81 in 1941.

In general, this method permits of the proportioning of the aggregates, water, and cement on the basis of a predetermined, field-manufactured strength of concrete as indicated by tests on beams poured during the paving procedure. The method was interestingly and accurately presented in the October, 1941, issue of ROADS AND STREETS in two articles by V. J. Brown, C.E., Publishing Director of the magazine. An essential of the employment of strength design is the required high grade character of engineering field control. Contractors are pleased to work under this specification because it gives them a greater latitude of action in aggregate selection and makes bulk cement proportioning advantageous. The full capacity of the controlling unit of concrete paving manufacture can be obtained and accessory equipment timed to

LET'S GO AMERICA!

We're in this thing to a finish . . . no longer is there any uncertainty about it. We have a job to do and the sooner we get it over the better. So let's put our shoulders to the wheel and help get the world out of the mud, mire and muck.

Galion road machinery has already been active in much of this Defense work . . . constructing airports, building access roads to defense plants, navy yards and airports, and working on defense highways throughout the land. Galion will continue to contribute to these "full-speed-ahead" programs calling for extra shifts and extra quality in road building and maintenance machinery.

There is no guesswork about Galion road machinery either . . . it has the ability to stay on the job until the finish . . . will see construction and compaction work through to successful conclusion. You can speed up with a Galion on the job.

Somewhere in the Pacific Northwest they're building airports, too; and the big Galion tandem (shown above) is being used for compacting the asphalt, making it ideal for the smooth take-off and happy landing. Hydraulic steering and diesel power—three sizes from 5 to 14 tons in weight. You don't select a tandem at random.

THE Galion IRON WORKS & MFG. CO.

Main Office and Works:
GALION, OHIO

Here you see (at left) one of the big Galion motor graders on a road widening job near a large aircraft plant—blading material preparatory to resurfacing. This unit has double drive, diesel power, leaning front wheels, wide front axle, full revolving circle and many other features to provide the utmost in performance and the lowest cost operation.

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operate with it. To secure maximum economy it is necessary that the specifications, the design, and the control of paving mixtures be such that the contractor may select materials, equipment and methods which will result in the greatest possible saving.

This type of specification places no limit on either the cement factor or the water-cement ratio. The concrete is designed for the specified modulus of rupture of beams at the age of seven days and the durability is assured by the use of sound aggregates and as a result of dense concrete. The proper water-cement ratio is determined from preliminary or pilot tests employing the actual cement and aggregates as proposed for use on the particular project. These preliminary tests are necessary before actual construction begins and may be divided into two subdivisions, the first being to determine the proper range of sand factors and coarse aggregate factors for the water-cement ratios chosen for the pilot beam tests in order to comply with the specification limitations on workability and consistency. The second step is to determine the proper water-cement ratio to give the strength required in the specifications. In further explanation they are:

(1) For the trial mixes, the first subdivision named above, only two water-cement ratios are selected, one well above and one well below the water-cement ratio for the required strength. Small mixes are made by hand, varying the sand factor for each of the selected water-cement ratios until a concrete is secured having the specified slump and satisfactory workability and plasticity. The sand factor is increased as the water-cement ratio is increased in order to maintain the proper plasticity and consistency desired in the mortar.

(2) Then using the proportions determined from the trial mixes, large mixes are made in the standard concrete paver (to be used on the job) and the slump and workability are checked in accordance with specification requirements. At least twenty standard beams are made for each of the selected water-cement ratios. The beams are cured in water at the specified temperature at the field laboratory and tested flexurally at the age of seven days by means of a center point loading on an 18-in. span. From these preliminary tests the sand factor limits and coarse aggregate factor limits are established for each water-cement ratio to produce concrete of the consistency and workability desired. A graph is platted, figure 1, which indicates the sand factor as the ordinate and the water-cement ratio as the abscissa. A second graph, figure 2, is platted which indicates the flexural strength in pounds per square inch as the ordinate and the water-cement ratio as the abscissa. As the construction progresses, job beams are made and the water-cement ratio is checked by averaging the flexural strengths of ten consecutive job beams. If the average strength of the ten consecutive flexural strength tests falls outside of the 25 pound band, above or below the designed strength, a new curve is drawn parallel to the original pilot beam curve and through the new point and the water-cement ratio is adjusted in order to secure concrete of the specified modulus of rupture as established by the specifications. With constant design factors the cement factor is a function of the voids in the coarse and in the fine aggre-

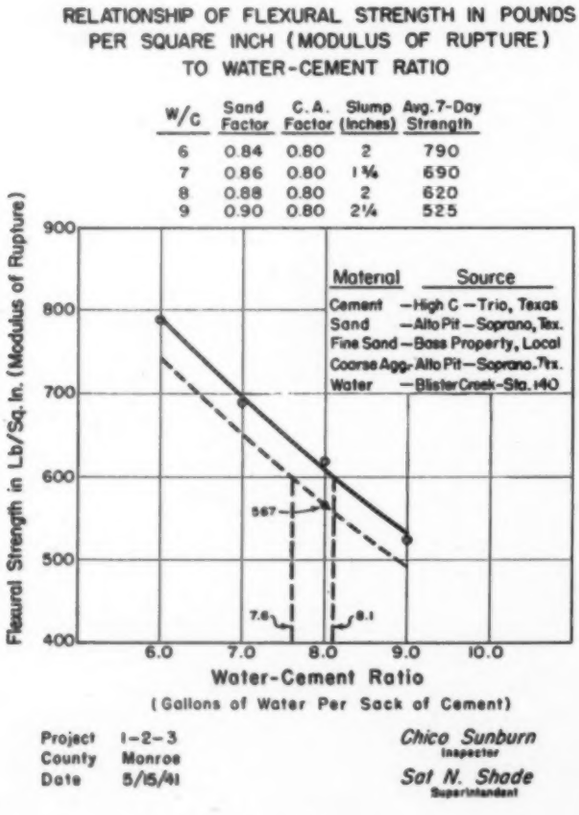


Fig. 1.—Relationship of Sand Factor to Water Cement Ratio as Determined by Small Trial Mixes

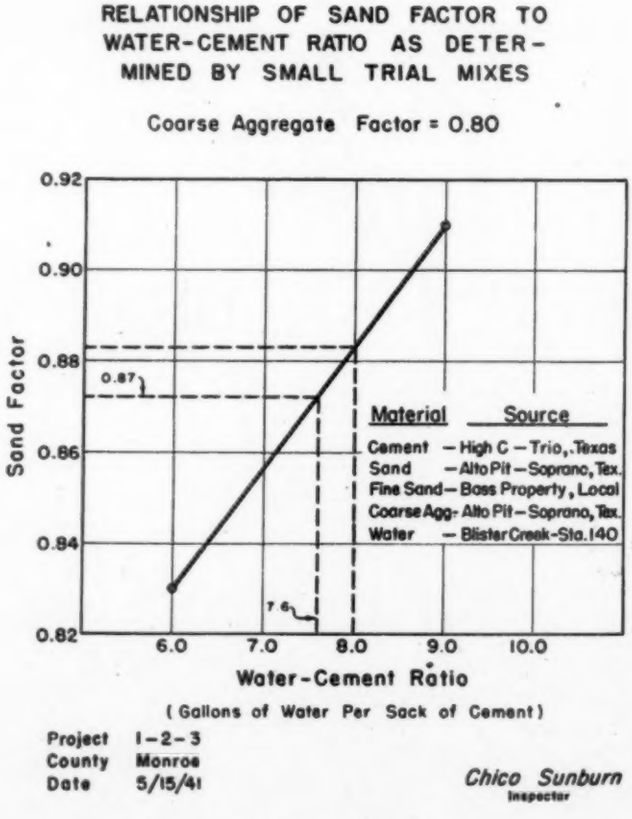


Fig. 2.—Relationship of Flexural Strength in Pounds Per Square Inch (Modulus of Rupture) to Water-Cement Ratio

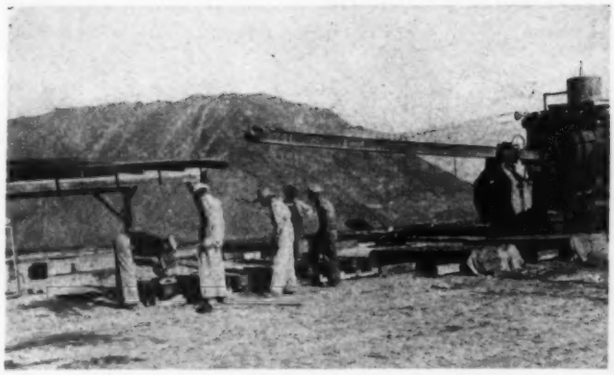


Fig. 3—Making pilot test beams at the plant. Curing vat is under shed in background

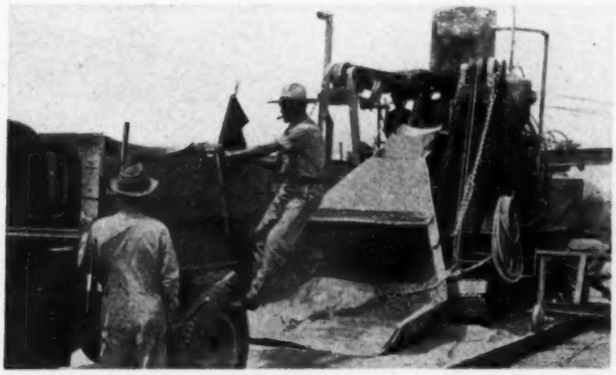


Fig. 4.—Inspector gets flag from truck. Attached to flag is a note from proportioning plant changing batch design

gates, increasing as the voids increase unless the factors used in the design are modified. It is apparent that the cement factor is a function of both the sand factor and the coarse aggregate factor and the cement factor decreases as either or both of these factors increase. It is imperative to adjust the sand factor and the coarse aggregate factor within the established range for these factors in order to realize the greatest economy with the materials available consistent with proper workability. As the job progresses slight changes are made in the mixture design, usually principally because of absorbed water content of the aggregates, to keep the strength to 600 lb. per sq. in., modulus of rupture of beam tested concrete, specified.

In field practice, this is a conservative figure. Over 700 lb. per sq. in. is being obtained.

Case Hardening of Concrete Surfaces

This method involving the use of absorptive lining on forms for concrete structures was first considered by the Bureau of Reclamation, Denver, Colorado, in May, 1938, and extensive laboratory tests were carried on to determine the practicability and usefulness of the method.

The Wyoming State Highway Department was the first to make field application of the results obtained in the Denver laboratory of the Bureau of Reclamation. Mr. Frank Kelso, Superintendent of the Wyoming State Highway Department reports as follows: "We first decided to try out the absorptive lining after having seen the results obtained in the Denver laboratories of the U. S. Reclamation Bureau, who we believe deserve all or most of the credit for initiating the use of this material. The effect obtained, of case hardening concrete surfaces by use of the material is truly remarkable aside from any merits it has in securing a uniform surface of pleasing appearance; free from water-pit-marks that are usually in evidence where the tight non-porous forms are used."

Wyoming used absorptive forms recently on two grade separation projects, namely, FAGM 13(1) at Rock Springs and FAGM 9(1) at Casper. The total areas of lined surfaces on these two jobs were 21,900 and 11,500 square feet, respectively. Only the surfaces exposed to view were lined. The specifications used for the absorptive material were practically those developed by the Bureau of Reclamation.

Mr. Frank Kelso further states, "Before we started using this material on our previous concrete jobs, it had been our practice to specify a rather low concrete slump of not over 2 inches where smooth forms were commonly used. The absorptive lining, however, has a relatively rough fibrous surface such that concrete mortar will not readily flow along it. Also care must be exercised to keep the concrete vibrator at least 4 inches away from the lining at all times, to avoid possibility of damaging its surface due to impact of vibrator or vibrating coarse aggregate next to the lining. As a result of these facts, we have found it best to use a larger concrete slump, say not less than three inches, and to vibrate the concrete at somewhat closer intervals along and parallel to the lined surfaces to safeguard against any honeycomb spots. This increased slump is of minor consequence, however, since the lining will readily absorb any excess water adjacent to it, leaving a dense surface of uniform texture, free of water-pit marks, and of quite pleasing appearance.

"In the few spots where patching was necessary due to our and the contractor's inexperience, the patch was finished by tightly pressing a piece of the absorptive lining against the freshly patched surface until the mortar had set. However, in our experience, the patched spot inevitably shows finally, to some extent.

"On both above jobs, the 'Firtex' brand of lining was used, and we believe it cost the contractor around 50 cts. per square foot installed. A large part of this cost is offset by the fact that cheaper outside form lumber can be used, and by the fact that no rubbing of concrete surface is required. The resultant concrete surfaces also have much greater density and hence are much more weather resistant.

"We understand also from the U. S. Reclamation Bureau, that the Goodrich Rubber Company, Akron, Ohio, are experimenting along the lines of a thin porous rubber absorptive lining which can supposedly be re-used, as against our present material which cannot be re-used.

"On our two jobs above mentioned, it happened that only two companies were asked by our award contractors to submit samples for testing, namely, the Fir-Tex and Celotex companies.

"We would call attention to a defect of the material, not mentioned above, namely, that the material swells some when wet. If it becomes thoroughly wet before use, as by a storm, it is liable to warp quite badly so as to be unfit for use. When wet concrete is placed against the absorptive lining, it therefore swells slightly, the ⅜ in. thickness of lining that we used swelled about 1/16 in. For this reason, casing nails (with small heads) must be used to attach it to forms so that nail heads will pull through on swelling. If a common nail is used, the head will not pull through, and the result will be a sort of raised pimple on the final concrete surface at each nail head. Also when nailing the material on forms, it is best to leave

More Speed

"TIME IS SHORT." So reads the sober reminder posted in a thousand busy defense plants from coast to coast. Engineers and contractors on defense work don't need to be told. They've been giving time a licking ever since America began to prepare.

Now they've got a new ally in their battle. Already the "Caterpillar" Diesel DW-10 Tractor is speeding up defense on a growing list of jobs.

Designed and built from the ground up for long, fast, heavy hauling, this unit is doing all that was expected of it, and more! It has the husky, economical power of a 98-hp. "Caterpillar" Diesel Engine. "Finger-tip" steering. "High-traction" differential. Short turning radius. Full floating seat. Heavy-duty constant mesh transmission. Five speeds forward. High clearance. Scientific weight distribution that gives super-traction for every use.

The "Caterpillar" Diesel DW-10 Tractor is amply powered to handle a big payload at 18 miles an hour. And it has all the advantages of simple, rugged, dependable "Caterpillar" construction, through and through.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

FOR VICTORY — *Our armed forces have first call on "Caterpillar" production. We thank customers who have suffered delivery delays by giving clear right-of-way to our Victory efforts.*

Some of the defense jobs where "Caterpillar" Diesel DW-10 Tractors are setting records for speed and economy are:

Fort Worth Bomber Plant, 4 units; Twin City Ordnance Plant, 10 units; Mississippi Ordnance Plant, 10 units; Lauderdale Airport, Mississippi, 4 units; Bermuda Base Construction, 16 units; Merced Airport, California, 3 units; Denver-Cheyenne Defense Highway, 3 units; Des Moines Arms Plant, 8 units.

CATERPILLAR

REG. U.S. PAT. OFF.

Diesel

ENGINES AND ELECTRIC SETS
TRACK-TYPE TRACTORS
WHEEL TRACTORS • ROAD MACHINERY

FOR THE DEFENSE JOBS!

Here's the "Caterpillar" Diesel DW-10 Tractor pulling "Caterpillar"-built W-10 Wagon, with capacity of 11 cu. yds., heaped measure.

This "Caterpillar" Diesel DW-10 Tractor is pulling a LeTourneau Carryall scraper.

The new "Caterpillar" Diesel DW-10 Tractor with LaPlant-Choate scraper moving earth on an airport job.

about a 1/16 in. open gap between the edges of adjacent sheets, which will close up when the material swells due to concrete moisture.

"This absorptive lining is a new material, and the manufacturers, we believe, are keenly alive to its defects as it now stands. We understand they are conducting experiments with a view toward eliminating some of its present defects. However, even as it is now made, we believe the material has enough positive advantages to more than offset its defects."

Fundamentally, advantages of absorptive form linings are based on the water cement ratio law, stated as follows:

For plastic mixtures, using sound and clean aggregates, the strength and other desirable properties of concrete under given job conditions are governed by the net quantity of mixing water used per sack of cement.

The hardening of the cement-water paste is due to the chemical reaction between the cement and water. These reactions require water and correct temperature for complete hydration. During the hydration period a certain amount of water chemically combines with the cement to become a permanent part of the concrete. To obtain plasticity more water is used than is required to combine with the cement during the curing period. This water evaporates and forms voids leaving a honeycombed surface. The absorptive material in the form lining takes up this excess water and leaves the smooth surface which is so desirable.

Scaling

Another problem — the scaling, cracking and crazing of concrete surfaces—is still being studied. In each case it has been assumed to be purely a local one. In Utah, admixtures of resinous materials have been used with some success although not enough time has elapsed to form definite conclusions.

As a result of studies made by the research division of the Michigan State Highway Department, the use of a wetting agent consisting of an admixture of 0.10 pound of a sulphated fatty alcohol per sack of cement on a paving contract stopped the bleeding of water from the concrete mix and the consequential formation of a neat cement top. This bleeding was caused by the rapid sedimentation of the aggregate.

The project in which this admixture was used was on U. S. 131 south of Kalkaska, Michigan. The pavement was a 9-7-9 in. thickness, 22 ft. wide.

The research division recommended the use of 7 pounds of sulphated fatty alcohol dissolved in 20 gallons of water. This was of necessity changed later to 5.6 pounds per 20 gallons and one quart of the admixture was added to each 7-bag batch.

The admixture was reported to have stopped the bleeding effectively. The material showed a 4 inch slump when tested directly from the paver. Five minutes later the same material showed a 2 inch slump. The spread concrete appeared fluffy and was covered with soapy bubbles. This admixture reduced the weight per cubic foot and consequently the strength. With the addition of the 7 pounds of material, difficulty was encountered in finishing due to the rapid settling of the material, as well as expected shrinking of the settled material. When the admixture was reduced to 5.6 pounds this difficulty disappeared. Finishing was made easier as was the cleaning of the mixture at the end of the day's run.

Parrish Joins OPM

W. M. Parrish, for a number of years in charge of International Harvester Company's industrial equipment sales to manufacturers, has been given leave of absence from the company to join the staff of the Office of Production Management at Washington as an adviser to the Automotive, Transportation and Farm Equipment Division of OPM.

Parrish has been an active figure in the road building industry for many years and served as president of the Manufacturers Division of the American Road Builders Association in 1938, 1939 and 1940.

Parrish got his first job in the automotive world in 1911 as a salesman selling Hupmobiles in the Central States. He was a factory representative dealing with dealers, thus beginning the career of wholesale selling which has engaged him since.

W. M. Parrish

In 1913 Parrish went overseas as a factory representative selling Gramm trucks to dealers. After the World War broke out he returned to this country, in November, 1914.

In January, 1915, he began his connection with Harvester at the Indianapolis branch as a motor truck salesman and made an outstanding record. He continued in that work until January 1917 when he took over the management of a plantation of 1,160 acres in Concordia Parish, Louisiana.

To handle his 600 acres in cotton, hay and corn, Parrish bought eight tractors and was one of the pioneer tractor farmers in Louisiana cotton farming. He introduced light tractors to farm use in that region and was the first to plant cotton with a check-row planter drawn by a tractor. This experience started him thinking on the possibilities of tractor use for ditching, stump pulling, road building and hauling.

In 1920 Parrish became factory representative for the Samson tractor (a division of General Motors at that time) doing dealer organization work in Mississippi and Louisiana, a job that gave him much practical tractor experience. In September, 1922, he joined the Ford Motor Company as a factory representative specializing on industrial tractors only. His operations centered in Chicago until 1923 when he was given added territory in the Central States, working with Ford dealers in industrial equipment and manufacturers of allied equipment.

In January, 1925, Parrish went back to the Harvester Company, as an industrial salesman, working from the General Office, calling on manufacturers of allied equipment, educating branch managers on the possibilities of industrial sales and helping to perfect the dealer organization.

Since that time he has been an important factor in the large increase in the Harvester Company's industrial business and has been widely known throughout the road building industry.

$50,000,000 *Street Reconstruction Program for Philadelphia.*—A 5-year $50,000,000 highway construction for Philadelphia with state funds has been authorized by the legislature. The act permits the city and state to enter into agreements whereby the state can rebuild certain Philadelphia streets. Expenditures for any one year can not exceed $12,000,000.

Modern Brick Pavements

A Review of Recent Practice and the Development of Centerline and Traffic Lane Markers

By W. H. CULLIMORE

Engineer-Secretary, National Paving Brick Association

ANNUALLY, states, counties and municipalities are spending millions of dollars for highway construction to provide for the safe movement of traffic from one point to another. Particularly in municipalities where large volumes of normally slow moving traffic is concentrated is it necessary to provide every facility for the free movement of traffic and to fully utilize the areas available for this purpose. Streets are designed to carry a certain number of lanes of traffic in each direction and yet in many instances traffic movement is greatly retarded because the lanes are not defined by markers which would confine traffic to the lane area. Failure in any way to utilize the street area to its fullest extent and assure a safer and speedier movement of traffic is false economy.

In municipalities where engineers are cognizant of this situation they have taken steps to apply traffic engineering principles. Traffic lanes at intersections and throughout the length of the thorofare are being designated. Regular maintenance of marker lines causes delay and further congests traffic. It develops into an annual maintenance problem at much expense.

Vitrified paving brick has proven, over a long period of years and by actual pavement service, its ability to withstand the rigor of both traffic and weather wear.

The installation of permanent brick lane markers of clearly contrasting color insures the engineer of full utility of the street width between curbs.

Paving brick for lane markers are not only used on brick paved streets but are being used as permanent lane markers with other type pavement surfaces.

Center Line and Traffic Markers on Brick Paved Streets

Many different designs have been used by the municipalities to define the center line and traffic lanes of the city streets.

On brick paved streets, probably the most effective design is the continuous buff colored centerline marker with offset edges which provides a solid colored line 4¼ in. wide and an overall width of 12¾ in. as shown by figure 1. This type centerline marker is usually used on streets having two or more lanes of traffic in each direction. To mark the traffic lanes, a straight line of buff colored brick are installed by placing the marker brick in every other course of brick. The traffic lanes are marked at 10 ft. intervals from the centerline.

On streets only wide enough for one lane of traffic in each direction, it is customary to install a centerline marker. This may be of the design described above for center line markers or the straight line of buff colored brick spaced every other course.

In some cities the traffic lanes have been defined by the installation of marker brick in every fourth course of brick. However this has not proven very satisfactory as there is too much space between marker bricks to give a clearly defined line.

At street intersections, it is good design and a safety measure to install a double row of marker bricks across the building and curb lines in each direction. This provides a definite outline of the cross-walkway for pedestrian traffic and a uniform stopping line for vehicles. See figure 2.

In marker brick construction the first step taken is the establishment of the center line of the street. All operations start from this point. Where a single buff colored marker is used, an offset line 4¼ in. off center (bricks are 8½ in. long) is established and spot points given every 25 feet. This allows checking as paving progresses. In the event that a solid buff colored marker with offset edges is used for the center line an offset line of 2⅛ in. is established; the buff brick in the first row of bricks is edged on this line, in the next row the buff marker brick is centered, which allows an overall width of 12¾ in. for the marker line, 6⅜ in. on each side of the center. Traffic lane markers are also located from the center line. In the brick dropping operation the marker brick for the center line are paved first, droppers or pavers work from center of street to curb, red brick are paved solid in this area, and after lines for the traffic lanes have been established the red brick are taken out along the marker line and replaced with buff brick. This method is found to be economical and also avoids confusion in the paving operation. After all marker brick are placed and rolled they are realigned to correct any distortion. The cutting in operation is held up until all markers are lined which allows shifting of brick where necessary.

On the brick paved streets where traffic lane markers have been installed, the movement of traffic has been made speedier and safer. Traffic is better regulated and the entire space between curbs is utilized to the fullest advantage.

Fig. 1.—Vitrified brick pavement with buff-colored marker brick. Centerline design of offset edges—4¼ in. solid line and overall width of 12¾ in. Traffic lane markers spaced every other brick

MOTOR GRADERS

Adams Motor Graders are offered in light, medium and heavy-duty sizes, with 31 to 68½ h.p. engines—gasoline and Diesel.

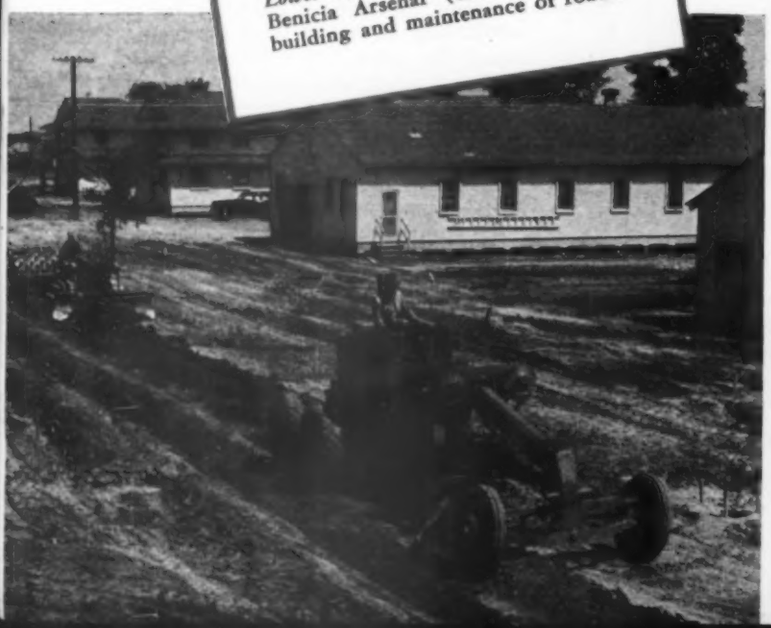
Above: 68½ h.p. Diesel model grading Boise Air Base at Boise, Idaho, for Morrison-Knudsen Company.

Lower Left: 50 h.p. Diesel model building roads at Baer Air Field, Indiana, for Harris Construction Co.

Lower Right: 31 h.p. model owned by Benicia Arsenal (Calif.)—used for building and maintenance of roads.

GOT A DEFENSE PROJECT to grade—an airport, ammunition dump, defense building site, access road? Let this modern Adams equipment handle it for you quickly and at low cost. All Adams machines are easy to operate, are readily adaptable to a wide variety of jobs and, above all, are good for 24-hour-per-day, dependable performance with a minimum of upkeep. Anticipate your requirements and see your local Adams representative now for full information.

J. D. ADAMS COMPANY, INDIANAPOLIS, INDIANA



...on those Grading Jobs...

LEANING WHEEL GRADERS

Furnished in 8, 10, and 12 ft. models, hand or power controlled. Capable of any type of surface, ditch, or bank work . . . Machine at right is building access roads to new airplane plant in Kansas.

ELEVATING GRADERS—Ideal for leveling most air field sites. Move a lot of dirt per day . . . Machine below is loading 10 yards of dirt per minute on the big new Mobile (Ala.) airport.

HAULING SCRAPERS—Available in several sizes for use with any tractor. Load easily—dump and spread quickly and to specifications. Ideal for all types of "short haul" grading . . . This 12½ yd. model is doing general grading and road building on the big Seneca Ordnance Depot project in New York.

★ ADAMS

Road Building and Earth Moving Equipment

Fig. 3.—Sheet asphalt paved intersection with buff-colored marker brick installed across the curb and building lines to define pedestrian walkways

Brick Markers Installed in Sheet Asphalt Pavements

During 1941, the Borough of Manhattan, New York City, decided to install marker brick across the curb and building lines at the intersection of 7th Avenue and 23rd Street to clearly designate pedestrian walkways and provide a stopping line for traffic. This is shown by figure 3.

The entire intersection was repaved with sheet asphalt on a concrete base. Double rows of light colored buff brick were installed in the asphalt surface for the full width between curb lines. An additional double row, extending from the curb, for one-half the width of the street, was placed nine inches back off the row across the building lines. The double line was constructed on the side of the street in line with the movement of traffic. This provides a uniform stopping line for traffic far enough back of the walkway markers to further insure the safety of pedestrians and comply with the traffic laws of New York City.

When the concrete base was constructed, a chase or groove, 8 inches wide, of the proper depth, was formed, using timbers set in the concrete base to the true line and grade at the locations where the marker brick were to be placed. The smooth surface marker brick were laid on a 1 in. sand cushion built on the concrete base. A sulphur asphalt filler was poured in the joints between the bricks. After the marker brick installation was completed, the asphalt binder and topping were laid in the adjacent areas and in the 9 in. space between double marker lines.

Considerable experience and knowledge was gained during this construction and it is now recommended that the marker brick be installed after the asphalt surface has been laid. Timbers of the correct width and depth could be laid in the chase or groove during the asphalt laying operation and after its completion the timbers removed and the marker brick (contrasting color) be laid longitudinally (brick 8½ in. long). This would eliminate the necessity for laying asphalt in such a narrow area.

It is felt that by installing the marker brick last, a better surface grade and cleaner marker line can be obtained.

In the Borough of Queens, New York City, the Division of Highways has installed a double row of marker bricks for a permanent center line on several of their newly constructed sheet asphalt pavements. Center line brick markers were installed on Horace Harding Boulevard, Vernon Boulevard and Northern Boulevard.

The double row of marker brick was laid longitudinally on a sand cushion with sulphur asphalt filler poured in the brick joints. This method of construction was similar to that previously described.

Brick Used to Beautify Dead End Areas Along East River Drive

When the East River Drive between 49th and 92nd Streets was built, extensive promenades and sitting areas were developed. Of particular significance, because of the cooperation between the Borough President's office and the Department of Parks on the planning, are those built over the Drive in Carl Schurz Park and the dead end areas at 56th, 57th and 58th Streets. What might have been barren, useless eyesores under less competent hands, have become attractive recreation areas. Out of sight and out of hearing, the Drive below carries six lanes of high speed traffic, while on the deck above old and young enjoy the full benefits of waterfront activities without the nervous distraction of traffic and noise; see figure 4.

At 57th Street, the largest of the dead-enders, the area is several feet below the street level and is surrounded on the west and north sides by brick walls which provide seclusion and protection from winter winds. The river and the south sides are enclosed by wrought iron fences. Paving bricks for the walks are dark red with light red borders and Dutch windmill emblem in the center. This motif was taken from the emblem of the first settlers who founded New Amsterdam. It has been reproduced in wrought iron, baked enamel, terra cotta and brick, and has been used on fences, bridges and directional signs as well as on pavements. To provide contrast between the two colors of brick in the emblem and the borders, light cement was used between the joints of the light red bricks and dark gray cement between the dark red. The brick paving provides not only interest in pattern and texture but a warmth in color which relieves the gray overtone of city buildings and streets. Ample benches are provided throughout the area to take advantage of all views and exposures.

Vibrated Monolithic Brick Construction

During the past summer a general inspection was made of all the vibrated monolithic brick roads constructed in Ohio by the State Highway Department since 1938. At the time of this inspection, approximately 14 miles of this type brick construction was in service on four state routes.

The inspection disclosed that, with the exception of minor defects mostly in connection with the expansion and longitudinal joints, these highways are serving in satisfactory manner. The defects noted can easily be taken care of by prompt and careful maintenance at small expense. Vibration construction is shown in figure 5.

The economy of this type brick road construction is recognized by the

Fig. 2.—Vitrified brick pavement, note traffic lanes and crosswalks for pedestrians of buff-colored marker brick.

fact that this year the Ohio Department of Highways has awarded four more contracts, totalling 127,000 sq. yds. of monolithic brick roadway, on 8½ miles of state highways.

Bridge Repaving Project

The highway bridge over the Delaware River, from Trenton, N. J., to Morristown, Pa., is a part of one of the heaviest traveled routes in the eastern section of the United States, being U. S. Route 1 which is the highway between New York and Philadelphia. The bridge is of three truss design, providing a four lane divided highway; two traffic lanes in each direction.

The bridge was originally paved with asphalt blocks.

The Delaware River Joint Toll Bridge Commission decided to remove a section of the asphalt blocks and lay an experimental section of brick pavement at the Morrisville, Pa., end of the bridge. The construction was done in November and was followed by a very severe winter. The new brick surface proved so satisfactory, being non-skid in character, that it was decided to repave the entire bridge with vitrified brick, using the Commission's own labor forces. Since then several sections of the bridge have been repaved at various times. The bridge was kept open to traffic every night during construction.

The repaving of one section was completed on July 17, 1941, and that night 2500 army trucks drove over the new brick pavement without any disturbance of the asphalt filler in the joints or breakage of the brick surface.

Vertical fiber lug brick, 2½ in. in depth, were used due to the fact that the asphalt block which were replaced were of this depth. The brick were laid on a ¾ in. mastic bed on a concrete base.

Tunnel and Underpass Projects

During the year, the City of Boston eliminated one of its most troublesome sources of traffic congestion when the new vehicular underpass at Huntington and Massachusetts Avenues was completed and opened to traffic. This project is known as the "Charles A. Innes Underpass." It is estimated that 14,000 cars will use the underpass in a 12-hr. day in the beginning and within a year the normal usage will increase to a total of 17,000 cars per 12-hr. day.

The underpass, which is about 850 ft. long, provides for four lanes of traffic, two in each direction. It is 43 ft. wide and has a clearance of 15 ft. There is a 3-ft. lane separation in the center. The entire underpass is surfaced with red vitrified paving brick on a mastic cushion with asphalt filler in the joints. The traffic lanes on each side are marked by a traffic line of yellow marker brick, as shown in figure 6.

Early in the past year contracts were let for the completion of the approach and the second tube of the Lincoln Tunnel in New York. The paving of the tube with vitrified brick is expected to be completed by the summer of 1942. The vitrified brick surface in the first tube of the Lincoln Tunnel is in splendid condition and has required no repairs or replacements after four years of heavy, concentrated traffic.

Research

Research, by means of observation, studies and tests, has continued in an effort to improve the utilization of the "manufactured product."

The fourth survey, representing three years of service of the "Acceptance Test Road" in Delaware County, Ohio, was made last fall by representatives of the U. S. Public Roads Administration, the Ohio Department of Highways, and the National Paving Brick Association. Tables covering the brick count of this survey have been compiled and from these data and the results of laboratory studies, many of the paving brick manufacturers have been able to correct defects in their plant operations and manufacture a much improved product.

Periodic inspections are being made of the "Filler Test Road" constructed on Route 31 in Hocking County, Ohio, in 1935 in cooperation with the Public Roads Administration and the Ohio Department of Highways. This brick roadway, which is one and one-quarter miles long, was allotted to the test of various types of joint filler. It is concerned mostly with the development of a paving brick joint filler which is non-exuding in hot weather. Of the fillers used in the test road, thirteen were in sections of about 300 ft. in length and eight in sections of shorter length. The National Paving Brick Association expects to publish a complete report on the filler test road after a field inspection this year.

Conclusion

At several of the Defense plants, vitrified paving brick have been used in the paving of floors, driveways and yards. Paving projects on streets and roadways in the Defense Highway program have been completed and many more are under construction for this year.

Because of its established record of service and maintenance economy, vitrified brick is well qualified to withstand the terrific punishment of heavy mechanized and motorized military equipment.

In the coming months, when all of America will be working towards one goal, the paving brick industry will be ready and doing its share in the great march toward Victory.

Fig. 4.—Sitting area and promenade at 57th Street above East River Drive. Dutch Windmill of vitrified paving brick in center, emblematic of first settlers who founded New Amsterdam

Fig. 5.—Vibrated monolithic brick roadway. Vibrating machine tamping brick at the rate of 3600 blows per minute. Grout filler used in joints

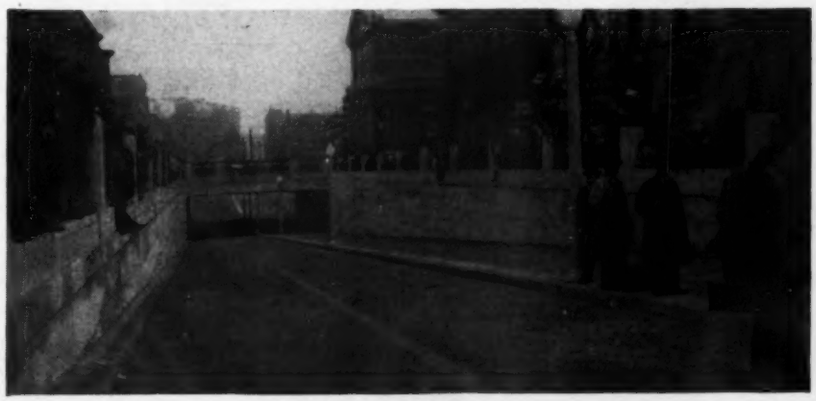


Fig. 6.—"Charles A. Innes Underpass," Boston, Mass., paved with vitrified paving brick on mastic cushion with asphalt filler in joints

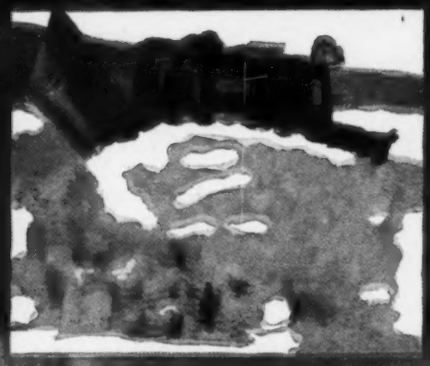
More Different Kinds of Snowplows Are Mounted on FWD Trucks Than Any Other Make of Truck or Tractor.

FWD Trucks Lead All Others . . .

KEEPING HIGHWAYS, CITY STREETS, AIRPORT RUNWAYS CLEAR THROUGHOUT THE SNOW BELT

Snow clearing of highways and city streets is no longer the costly, time-consuming, piecemeal job it used to be, where often 2 miles per hour of snow cleared road and even slower speeds were considered fair work. FWD trucks have settled the problem for the majority of highway departments throughout the snow belt. The super-power, speed and full four-wheel-drive traction of an FWD truck open the road and keep it open — faster, more dependably and at lower cost per mile than any other type of snow removal equipment. Contrasted with former methods, FWD's open roads at speeds up to 30, and in cases where snowfall is not too heavy, 45 miles per hour.

Snow removal need not be a "headache" for highway men and taxpayers alike. With FWD trucks on the job even the most severe blizzard causes only a temporary interruption in traffic flow, and the revenue from gasoline taxes and other transportation sources keeps coming in a way that frequently pays for a whole winter's snow removal.



Mountain highways are subject to heavy snowfalls and deep drifts in low spots. The full four-wheel-drive power and traction of an FWD cuts a clean swath usually the first time through.

Keewenaw County drivers — "champion snow busters" — won the championship trophy in the annual Michigan snow-plowing contest with their FWD M7. The 1941 champions who are shown above rolling back the shoulder, plowed an open roadway 20 feet wide and 300 feet long in four minutes and 37 seconds.

These FWD Men Put Their Experience Into FWD Trucks

R. H. Schmidt, FWD's General Sales Manager, has been working with truckers for more than 25 years — knows snow removal and truck transportation from firsthand experience. Ten years on the job as FWD's Service Manager showed him what snow removal operators need in a truck. A good man to know when you are thinking about snow removal.

H. V. Larson, Chief Inspector and Experimental Engineer — started with FWD February, 1915 . . . founded the Inspection Department — the first in the truck industry to have 100 per cent inspection of all parts used. Larson pioneered the development of FWD four-wheel-drive trucks for wide field of application.

Chester A. Kasten, Chief of FWD's Final Truck Inspectors, relies on fifteen years inspection experience with FWD to back up his OK on a new FWD before it leaves the factory. "Chet" has had 25 years experience in the trucking industry—drove a truck for nine years—knows how a driver likes to have a truck perform.

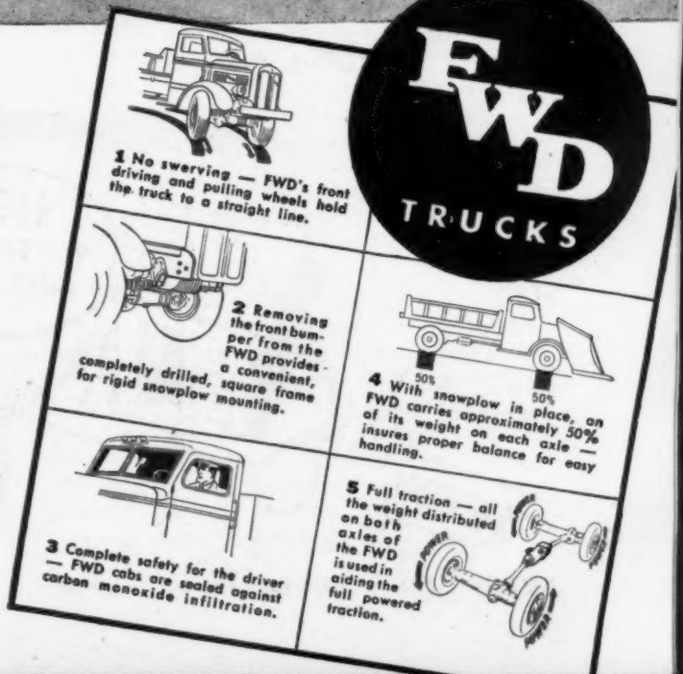
Rotary plows, "V" plows, plows of every practical type, can be swiftly and securely mounted on FWD trucks because they have been designed to provide proper snowplow mounting facilities. It is a significant fact that more different kinds of snowplows are mounted on FWD trucks than any other make of truck or tractor.

FWD trucks have earned and kept first place in the field of motorized snow equipment for many reasons . . . special heat-treated steels developed to provide the maximum of resistance against failure in sub-zero temperatures — special gear ratios — tremendous reserve power — the full and balanced traction of four driving wheels—the properly calculated weight distribution that gives an FWD stability on bumpy, slippery surfaces — these and many other features not found in an ordinary motor truck merely equipped with a snowplow.

Write for the complete FWD performance record on snow removal. Investigate the truck that yields the biggest all-year, all-season returns on the investment.

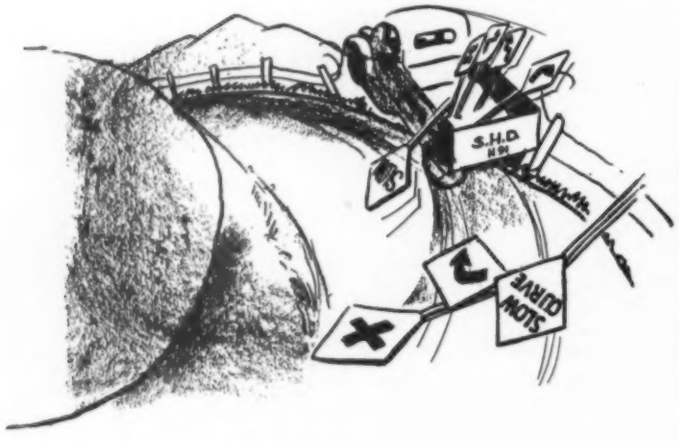
THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis., U. S. A.

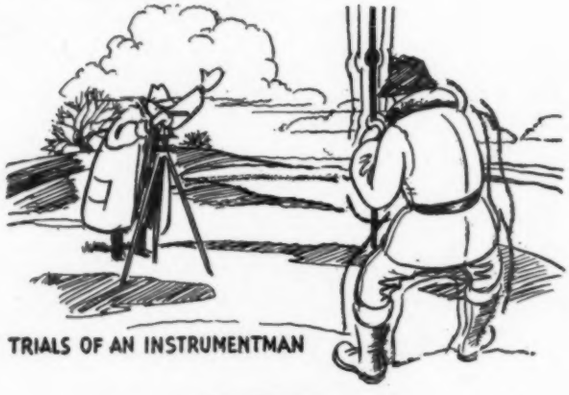
Canadian Factory: KITCHENER, ONT.



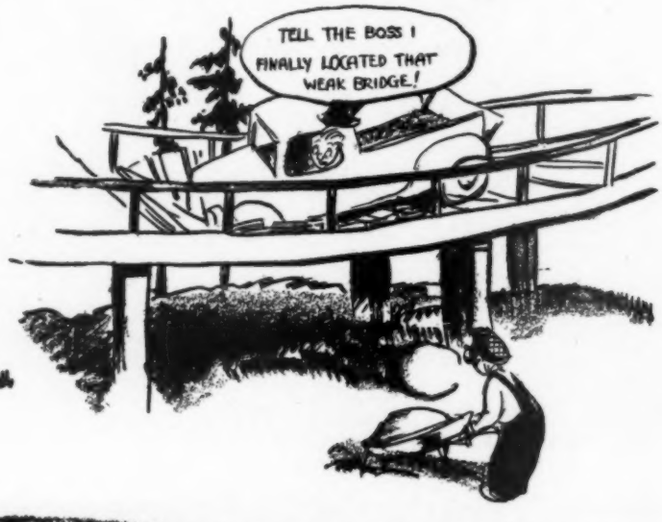
OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER





TRIALS OF AN INSTRUMENTMAN



¶ Compliments are in order for the engineers of Ohio. Since Hal Sours took over as chief engineer (director now) the surfaces of Ohio's highways have undergone a "face lifting" job of the first order. Road surfaces formerly rough and pot-holed are now smooth. Narrow roads have been widened, low shoulders have been raised. Many "Slippery When Wet" surfaces have been skidproofed, and traffic-lining has been expanded to practically every road in the state. What a relief it is now to drive Ohio's highways compared with only two or three years ago.

• •

¶ Another thing to be complimented in Ohio is the "Ice Control" barrels and buckets of grit on the steeper grades. The highway system in Ohio now begins to show a job of good housekeeping. Congratulations to all.

• •

¶ Teacher: "Jimmy, will you use the word 'torture' in a sentence?"

Jimmy: "Hearing a loud rap at the door he leaped from her embrace, exclaiming, 'I torture husband was in Texas'."

• •

¶ A certain breeder of dairy cattle in one of the southern states is distinguished for two things—the excellent quality of his cattle and his relentless insistence on his hired hands keeping busy. A negro came to him one day and applied for a job as milker.

"You don't look to me like a nigger that wants a steady job," replied the dairyman, eyeing him critically.

"Yassuh, boss, Ah wants a stiddy job."

"Well, go to work, then, but I'm telling you, I don't like your looks."

The negro went, and found that he not only had to milk twenty cows, but care for the milk, wash the utensils, curry the cows and feed them, clean the stalls, and drive the cows to and from the pasture. In fact, he put in about eighteen hours a day. He was game, and stayed with it for two months. Then he gave notice.

"I knew it! I knew it!" railed the dairyman. "I knew you didn't want a steady job, you no account rascal!"

"Yassuh, boss, Ah does," protested the darky, "but you's been layin' me off six hours ever' night."

• •

¶ "Now, look here, I fired three girls for revising my letters, see?" said the boss to his new steno.

"Yes, sir."

"All right, now take a letter and take it the way I tell you."

And the next morning Mr. O. J. Squizz of the Squizz Soap Company received the following letter:

"Mr. O. K. or A. J. or something, look it up, Squizz, what a name, Soap Company, Detroit, that's in Michigan, isn't it? Dear Mr. Squizz, Hmmmmm. You're a hell of a business man. No, start over. He's a crook, but I can't insult him or the bum will sue me. The last shipment of soap you sent us was of inferior quality and I want you to understand—no, scratch that out. I want you to understand—Hmmmm—unless you can ship—furnish—ship, no furnish us with your regular soap, you needn't ship us no more period or whatever the grammar is, and pull down your skirt. This damn cigar is out again.

"Where was I? Paragraph. Your soap wasn't what you said—I should say it wasn't! Them bums tried to put over a lot of hooey on us. Whadda you flappers want to paint yer faces up for like Indians on the warpath? We're sending back your last shipment of soap tomorrow. Sure, we're gonna send it back. I'd like to feed it to 'em with a spoon an' make 'em eat it, the dirty bums. Now read the letter over—no, don't read it over, we've wasted enough time on them crooks, fix it up and sign my name. What do you say we go out to lunch?"—*Twice Told Tales.*

• •

¶ A contractor, awaiting a happy family event, had fortified his courage at the decanter. At length the nurse appeared with twins in her arms. The happy father blinked and drew himself up proudly: "What a beautiful baby!" he exclaimed.

• •

¶ A woman resident in China remonstrated with her houseboy for taking her linen into her bedroom without knocking.

"That all right, Missy," said the native. "Every time come, lookee through the keyhole. Nothing on, no come in."

• •

¶ Cop: "Hey, there, just a minute, mister, where are you going to this time of night?"

Wanderer: "I'm—hic—going to a lecture."

• •

¶ Engineer who had just returned from duty in the tropics: "The jungle was all around us. Ammunition, food and whisky had run out, and we were parched with thirst!"

Listener: "But wasn't there any water?"

Engineer: "Sure. But it was no time to be thinking of cleanliness."

¶ One driver reported: "I was going home to eat. I gets around the corner. There suddenly comes a trolley car. To avoid an accident I runs over a pedestrian."

• •

¶ Information Clerk: "Madam, this train goes to Omaha and points West."

Madam: "Young man, I want a train to Oshkosh, and I don't care which way it points."

• •

¶ It was during the impanelling of a jury that the following colloquy occurred:

Judge: You are a property owner?

Prospective Juror: Yes, Your Honor.

Judge: Married or single?

Prospective Juror: I have been married five years, Your Honor.

Judge: Have you formed or expressed an opinion?

Prospective Juror: Not in five years, Your Honor.

• •

¶ Wisdom is made up of ten parts, nine of which are silence, and the tenth, brevity.

A sharp tongue and a dull mind are usually found in the same head.

Everybody knows how to express a complaint, but few can utter a graceful compliment. It takes practice.

A good citizen is a person who would behave just as he does if there were no laws.

A gloomy day only makes a human rainbow more noticeable.

Only a few watch the game closely enough to hate the umpire at the right time.

• •

¶ Begins to look tough for A. P. J. Better stay out of Detroit:

In Detroit, John Fletcher Jones was arrested for driving 48 miles an hour with one hand while he shaved himself with an electric razor plugged into the dash board.

• •

¶ Old Lady: "I suppose you and your husband worry a lot because you don't have any children after being married three years."

Young Lady: "Oh, yes; we've spent many a sleepless night because of it."—*The Yellow Strand.*

• •

¶ At the last meeting of the Highway Research Board, Professor Diefindorf who was a long way down the table, proposed a toast, and though he was not on the toast list, the chairman allowed him to proceed:

"My toast is that of 'Our Absent Friends'," he said, "coupled with the name of the waiter who has not been near this end of the table all evening."

"Preference Rating Order P-22 Amended" Revoked

New Order Issued

THE Office of Production Management issued a new Preference Rating Order — P-100 — which supersedes the Maintenance and Repair Order P-22 Amended. It became effective on December 18, 1941. This is a rapid change since it was only last month that we published the "P-22 Amended" order.

Although the provisions of the new order follow very closely those of the original one, several important changes have been made and it is therefore advisable to study the new order very carefully before taking any action. The differences between P-100 and P-22 are largely technical. However, some provisions of the old plan have been liberalized and a number of clarifications have been made in order to eliminate misunderstandings and misapplications of the order which occurred in the past.

Interpretations of Preference Rating Order P-22 Amended, heretofore published, remain in full force and effect under the new order.

Preference Rating Order P-100 which became effective on December 18, 1941, follows:

TITLE 32—NATIONAL DEFENSE
CHAPTER IX
OFFICE OF PRODUCTION MANAGEMENT
Subchapter B—Priorities Division
Part 958
REPAIRS, MAINTENANCE, AND OPERATING SUPPLIES PREFERENCE RATING ORDER P-100

958.2 For the purpose of facilitating the acquisition of Material for (1) the maintenance and repair of the property and equipment of producers as hereinafter defined, and (2) the continued operation of the property and equipment of such producers, a preference rating is hereby assigned to deliveries of such Material upon the terms hereinafter set forth. Such terms shall control until such time as the Office of Production Management certifies specific quantities of such Material to which the preference rating herein assigned may be applied, or until the Office of Production Management may specifically limit production by any type of producer or withdraw any type of Material from use by such producer, or until the Office of Production Management may issue an order specifically relating to the maintenance, repair and operation of the property and equipment of any type of producer.

(a) *Statement of Policy.* It is the purpose of this Order to effectuate the policy of the Supply Priorities and Allocations Board in maintaining governmental, charitable, and industrial property located in the United States, its territories and possessions, including the Philippine Islands, upon an adequate operating basis, without expansion or improvement of facilities except where duly authorized or approved. The terms and conditions of this Order are to be interpreted in conformity with this expressed policy.

(b) *Definitions.*

(1) "Producer" means:

(i) any governmental unit;

(ii) any individual, partnership, association, corporation, or other form of enterprise engaged in one or more of the following capacities to the extent that it is so engaged or so acts;

(a) manufacturing, processing, or fabricating;

(b) warehousing — maintaining warehouses for storage or distribution of any Material;

(c) wholesaling — acting as a distributor of products sold to manufacturers, wholesalers, retailers, or other persons not consumers;

(d) charitable institutions — any charitable or eleemosynary institution which is recognized as such for purposes of the Internal Revenue Laws of the United States;

(e) carriers — urban, suburban, and interurban common or contract carriers of passengers or freight by electric railway, electric coach, motor truck, or bus, including terminals of any of the foregoing; railroads, including terminals; shipping —commercial carriers of freight and passengers by ocean, lake, river, or canal, including terminals;

(f) educational institutions including vocational training);

(g) printers and publishers;

(h) radio—commercial broadcasting and communication;

(i) telephone and telegraph communication, including wire services;

(j) hospitals, clinics, and sanatoriums;

(k) Petroleum and Natural Gas—discovery, development and depletion of pools of petroleum and associated hydrocarbons, and derivatives thereof, and transportation of petroleum, associated hydrocarbons and derivatives thereof;

(l) irrigation systems, whether publicly or privately owned; owned; toll bridges and toll canals.

(iii) Any person using tools or equipment to repair or maintain the property of any Producer as defined in (b) (1) (i) and (ii).

(2) "Material" means any commodity, equipment accessories, parts, assemblies, or products of any kind.

(3) Subject to subparagraph (6), "Maintenance" means the upkeep of a Producer's property and equipment in sound working condition.

(4) Subject to subparagraph (6), "Repair" means the restoration of a Producer's property and equipment to a sound working condition when such

MOTHER - here comes the SNOGO!

A LITTLE boy swinging a friendly arm—a little mind whose memory wings back a year to a bitter winter night when lying before the fire with sharp pains in his right side he watched his mother pace nervously from the fire to the window and back to the fire again. Finally above the howl of the wind came the rumble of heavy motors and he was bundled in blankets out into the cold—friendly arms pulled him into the big, warm cab. Snogo had won another battle!

It's not an isolated instance in these days of decentralization. It happens every winter over and over again. But that's Snogo's job—to save lives, time and money. The County that has Snogo protection has real winter snow insurance, that will meet any snow problem. If Snogo can't do it no snowplow can. Roads will be open. There will be no dangerous one-way bottlenecks caused by drifting. Snow damage and road repair will be held to a minimum because Snogo puts the snow off the road where it can do no harm. Children will get to school—and back. Men are assured of reaching work, and emergency goods will move.

With a Snogo of a price and size to meet every budget every county in the snow belt can be assured of open roads, greater winter safety and continued industry to meet the emergency.

KLAUER MANUFACTURING CO., Dubuque, Iowa

THERE IS A SNOGO FOR EVERY BUDGET—FROM A 1½ TON TO THE LARGEST FOUR WHEEL DRIVE TYPE OF TRUCK

SNOGO For Complete Snow Removal

Defense Depends on Open Roads

property or equipment has been rendered unsafe or unfit for service by wear and tear, damage, destruction of parts, or similar causes.

(5) Subject to subparagraph (6), "Operating Supplies" means any Material which is essential to the operation of the Producer's business and which is consumed in the course of such business including, but not limited to, lubricants, catalysts, small perishable tools, and ferrous material necessary for the fabrication of containers: *Provided*, it shall not include

(i) any Material which is physically incorporated, in whole or in part, into any material which the producer manufactures, distributes, sells, stores or transports; or

(ii) any material that is to be used as fuel; or

(iii) any non-ferrous material to be used as packaging supplies.

(6) The terms "Maintenance," "Repairs," and "Operating Supplies" *do not* include the following:

(i) The replacement of an item carried on the Producer's books as a fixed asset;

(ii) material which would not be carried on the Producer's books as Maintenance, Repairs, Operating Supplies, or the equivalent, in the Producer's established method of bookkeeping;

(iii) material for the improvement of a Producer's property or equipment through the replacement of Material in the existing installation, unless such equipment is beyond economic repair;

(iv) material for additions to, or expansions of, such property or equipment.

(7) "Supplier" means any person with whom a purchase order or contract has been placed for delivery of material to a Producer or another Supplier.

(c) *Assignment of Preference Rating.* Subject to the terms of this Order, Preference Rating A-10 is hereby assigned:

(1) to deliveries, to a Producer, of Material required by him as Operating Supplies or for the Maintenance or Repair of his property or equipment;

(2) to deliveries to any Supplier, who has received purchase orders rated under this Order from a Producer or from another Supplier, of Material which will be delivered by him or by another Supplier to the Producer to fill such rated orders, or which will be physically incorporated into Material which will be so delivered; or which will be used within the limitations of paragraph (f)(2) hereof, to replace in such Supplier's inventory Material delivered to fill orders rated pursuant to this Order or pursuant to Preference Rating Order No. P-22, as heretofore amended. *Provided*, that when any General Preference ("E" or "M") Order assigns a specific preference rating to deliveries of any particular Material to be used by a particular industry or for a specific purpose, such preference rating shall control and the A-10 rating hereby assigned may not be applied; and *provided further*, that the preference rating hereby assigned may not be applied to deliveries of any Material to be used for purposes prohibited by any Order or Regulation issued by the Director of Priorities.

(d) *Persons Entitled to Apply Preference Rating.* The Preference Rating hereby assigned may be applied by:

(1) a Producer;

(2) any Supplier provided deliveries to a Producer or another Supplier are to be made by him, which are of the kind specified in paragraph (c) and have been rated pursuant to this Order.

(e) *Application of Preference Rating.*

(1) A Producer or Supplier, in order to apply the preference rating to deliveries of Material to him, must endorse the following statement on the original and all copies of the purchase order or contract for such Material manually signed by a responsible official duly designated for such purpose by such Producer or Supplier:

"Material for Maintenance, Repair, or Operating Supplies—Rating A-10 under Preference Rating Order P-100 with the terms of which I am familiar."

"....."

Name of Producer or Supplier

"....."

Signature of Designated Official

Such endorsement shall constitute a certification to the Office of Production Management that such Material is required for the purpose stated and that the application of the rating is authorized by this Order. Any such purchase order or contract for such Material shall be restricted to Material the delivery of which is rated in accordance herewith.

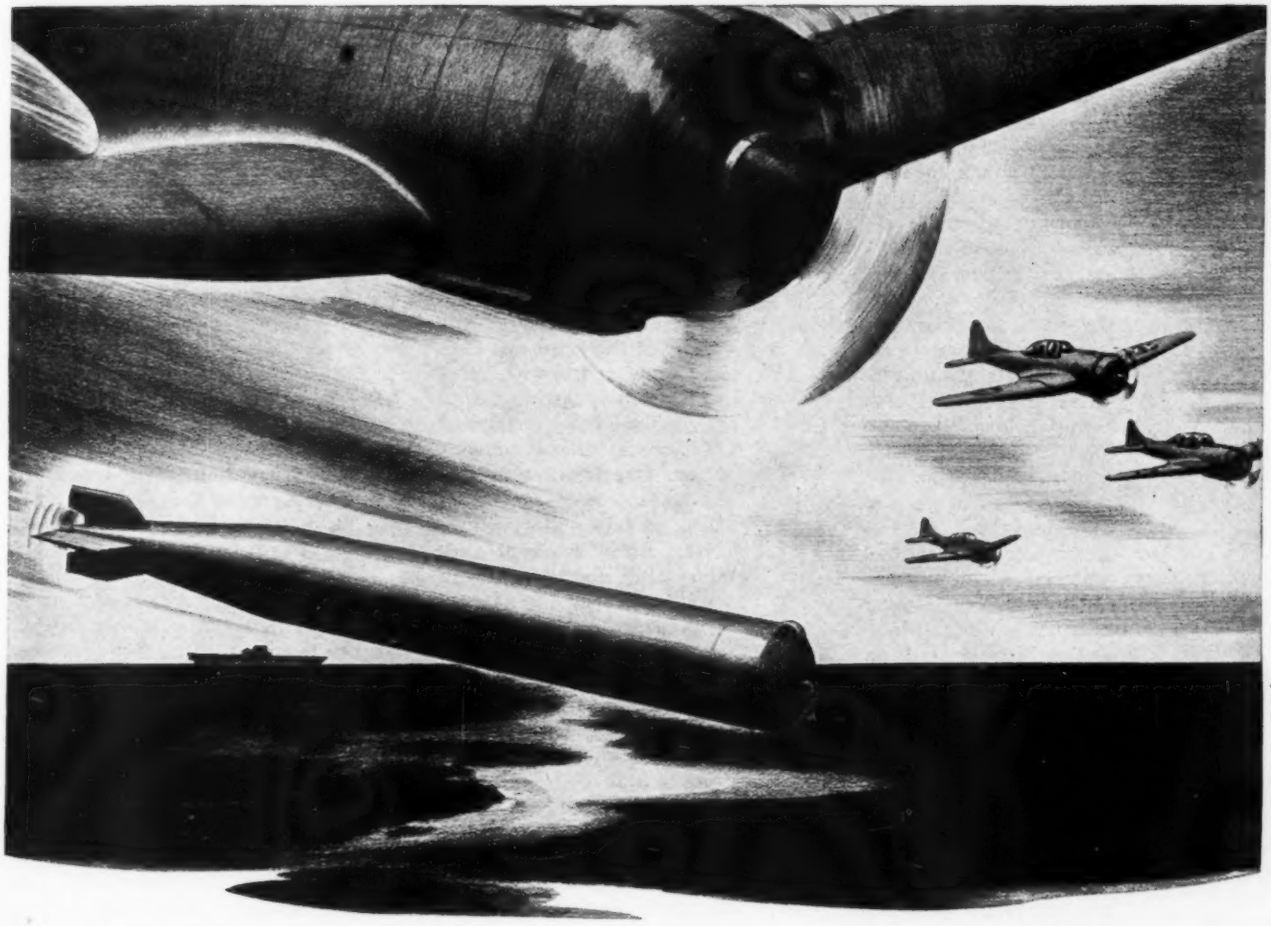
(2) The Producers and each Supplier placing or receiving any purchase order or contract rated hereunder, shall each retain, for a period of two years, for inspection by representatives of the Office of Production Management, endorsed copies of all purchase orders or contracts, whether accepted or rejected, segregated from all other purchase orders or contracts or filed in such manner that they can be readily segregated for such inspection.

(f) *Restrictions on Use of Rating.*

(1) Restrictions on Producer and Supplier — No Producer or Supplier may apply the rating hereby assigned to obtain scarce Material, the use of which could be eliminated without serious loss of efficiency by substitution of less scarce Material or by change of design.

(2) *Restrictions on Supplier*

(i) No Supplier may apply the rating to obtain Material in greater quantities or on earlier dates than required to enable him to make on schedule a delivery rated hereunder or, within the limitations of (ii) and (iii) below, to replace in his inventory Material so delivered. He shall not be deemed to require such Material if he can make his rated delivery and still retain a practicable working minimum inventory thereof; and if, in making such delivery, he reduces his inventory below such



5,500 Aerial Torpedoes for Uncle Sam from Steel Conserved by Preformed Wire Rope

★ Preformed wire rope can help you meet emergency production demands because it wears longer than ordinary or non-preformed cable. Lasting longer, it reduces machine shutdowns for replacement. And that steadies production—makes man and machine hours more productive. In addition, preformed wire rope is easier, faster, safer to handle. It saves both time and money.

★ Now there is another reason for using preformed wire rope. Through its ability to last longer, *it conserves steel for other National Defense requirements.* Indeed, the steel conserved by the use of long-wearing preformed wire rope, in 1941 alone, would be enough to fabricate more than 5,500 aerial torpedoes.

★ Preformed wire rope is an essential to American industry—a necessity for the Nation.

PREFORMED WIRE ROPE

Ask Your Own Wire Rope Manufacturer or Supplier

minimum, he may apply the rating only to the extent necessary to restore his inventory to such minimum.

(ii) A Supplier who supplies Material which he has in whole or in part manufactured, processed, assembled or otherwise physically changed may not apply the rating to restore his inventory to a practicable working minimum unless he applies the rating before completing the rated delivery which reduces his inventory below such minimum.

(iii) A Supplier who supplies Material which he has not in whole or in part manufactured, processed, assembled or otherwise physically changed may defer application of the rating hereunder to purchase orders or contracts for such Material to be placed by him until he can place a purchase order or contract for the minimum quantity procurable on his customary terms; *provided*, that he shall not defer the application of any rating for more than three months after he becomes entitled to apply it.

(g) *Restrictions on Withdrawals and Inventory.*

(1) Except as provided in paragraph (g) (3) and (4), no Producer who has applied the ratings assigned hereby shall, at any time, accept deliveries (whether or not rated pursuant to this Order) of any Material to be used as Operating Supplies or for Maintenance or Repair until the Producer's inventory and stores of Material to be used for these purposes have been reduced to a practicable working minimum. Such practicable minimum shall in no event exceed one hundred ten percent (110%) of the maximum dollar volume of Material to be used as Operating Supplies and for Repairs and Maintenance in inventory and stores during the corresponding calendar quarter of 1940.

(2) Except as provided in paragraph (g) (3) and (4), no producer who has applied the ratings assigned hereby shall, during any Calendar Quarterly Period, make withdrawals from stores or inventory of any Material to be used as Operating Supplies or for Maintenance or Repair the aggregate dollar volume of which shall exceed one hundred ten percent (110%) of the aggregate dollar volume of the withdrawals of such Material during the corresponding quarter of 1940, or, at the Producer's option, twenty-seven and one-half percent (27½%) of the aggregate dollar volume of the withdrawals of such Material during the calendar year 1940.

(3) From time to time the Director of Priorities may determine that certain Producers are exempt, in whole or in part, from the restrictions contained in paragraph (g) (1) and (2).

(4) Restrictions contained in paragraph (g) (1) and (2) shall not apply to any Producer during any Calendar Quarterly Period in which

(i) the total volume of his purchases of Material for Maintenance, Repairs and Operating Supplies does not exceed five thousand dollars ($5,000); and

(ii) the total volume of his withdrawals of Material for such purposes does not exceed five thousand dollars ($5,000).

(h) *Audits and Reports.*

(1) Each Producer or Supplier who applies the preference rating hereby assigned, and each person who accepts a purchase order or contract for Material to which the preference rating is applied, shall submit from time to time to an audit and inspection by duly authorized representatives of the Office of Production Management.

(2) Each such Producer or Supplier shall execute and file with the Office of Production Management such reports and questionnaires as said Office shall from time to time request. No such reports shall be filed until such time as the proper forms are prescribed by the Office of Production Management.

(i) *Utilities and Mines Excepted.* This Order is not applicable to any Utility defined as a Producer in Preference Rating Order No. P-46 (section 978.1) as amended from time to time, nor to any Operator as defined in Preference Rating Order No. P-56 (section 982.1). The Director of Priorities may from time to time specifically except further classes of Producers from this Order by specific direction.

(j) *False Statements and Penalties.* Any person who applies the preference rating hereby assigned in wilful violation of the terms and provisions of this Order, or wilfully falsifies any records which he is required to keep by this Order, or who obtains a delivery of Material by means of a material and wilful misstatement will be forbidden to further apply said rating. Such person may also be prohibited from obtaining further deliveries of Material under allocation and be deprived of any other priorities assistance. The Director of Priorities may also take any other action deemed appropriate, including the making of a recommendation for prosecution under section 35 A of the Criminal Code (18 U.S.C. 80).

(k) *Revocation or Modification.* This Order may be revoked or amended by the Director of Priorities at any time as to any Producer or Supplier. In the event of revocation, or upon expiration of this Order, deliveries already rated pursuant to this Order shall be completed in accordance with said rating, but no applications of this rating to any other deliveries shall thereafter be made by the Producer or Supplier affected by said revocation or expiration.

(l) *Effective Date.* This Order shall take effect immediately.

(P.D. Reg. 1, Aug. 27, 1941, 6 F.R. 4489; OPM Reg. 3 Amended, Sept. 2, 1941, 6 F.R. 4865: E.O. 8629, Jan. 7, 1941, 6 F.R. 191; E.O. 8875, Aug. 28, 1941, 6 F.R. 4483; sec. 2(a), Public No. 671, 76th Congress, Third Session, as amended by Public No. 89, 77th Congress, First Session; sec. 9, Public No. 783, 76th Congress, Third Session.)

Issued this 18th day of December, 1941.

(Signed) D. M. Nelson
Donald M. Nelson
Director of Priorities

Priorities Regulation No. 1 Amended

Priorities Regulation No. 1, the basic document which governs the operations of the priority system, has recently been amended in several important respects.

Most important of the changes is a requirement that *all* orders bearing a priority rating, including B ratings for essential civilian orders as well as A ratings for defense orders, must be accepted by producers, in preference to any unrated order. Previously the acceptance of B-rated orders was not mandatory.

The required acceptance of B-rated orders is a further transitional step in the move toward allocation of scarce materials, since B ratings are one method of designating the relative importance of civilian uses for materials after war requirements have been met.

Treatment which must be given to defense orders is clarified by a new provision which assigns a priority rating of A-10 to all defense orders not otherwise rated. This change is intended to eliminate any confusion which might arise as to the handling of those defense orders which were previously unrated, in relation to other orders which had been specifically rated A-10, the lowest rating in the A series.

Section 944.14 of Priorities Regulation No. 1 has been revised to provide a stricter limitation of inventories. Whereas producers were previously forbidden to increase their inventories beyond the amount necessary to meet required deliveries of their products, they are now forbidden to accept delivery of materials for inventory in excess of a practicable working minimum. This means that all inventories of any materials whatever must be reduced to a practicable working minimum, strictly construed, before they can be replenished. The prohibition applies to supplies of materials for inventory as well as to producers who maintain inventories, and it covers non-defense as well as defense producers. An exception is made, however, for inventories of materials imported from foreign countries.

A possible loophole in the inventory restriction is closed by a provision that no material may be fabricated, processed, alloyed or otherwise altered if the producer's inventory of the material in its altered form would thereby be increased beyond a practicable working minimum, unless specific authorization is granted by the Director of Priorities.

Another amendment will help to prevent receipt of a new, high-rated order from interfering with fulfillment of the delivery date on a previously accepted lower-rated order. Unless the new order bears an AA rating or is accompanied by specific direction from the Director of Priorities, it will not have to be accepted if its acceptance would necessitate pre-empting material which has already been completed to fill a previously accepted defense order which bears a lower rating, or if it would pre-empt material which is within fifteen days of completion. Or, if the new order is accepted, the producer may not divert material already completed or about to be completed on a previous defense order for use in filling the new order.

National Inventory of Trucks and Buses Started

As part of the transportation planning for national defense, a national defense inventory of trucks and buses was started in most states on Sept. 25, and in the others a few days later. The size of truck and bus operations in the country is indicated by the fact that more than 6,000,000 questionnaire-cards are required in the canvass.

EDITORIAL

Organizing Defense

MENTION of national defense usually conjures to the mind of the common citizen hosts of airplanes for bombing or fighting, tanks in droves or battleships cutting through the ocean swells. The confused picture usually visualized by the average citizen is one of columns of marching men, long lines of covered trucks, camouflaged guns barking, and planes peeling off for the dive. He recalls newspaper scareheads and emotional radio announcing.

Entirely obliterated from this throbbing, emotional, drumming picture is the steady work of the civilian groups quietly organizing in every community in the land for the protection of the public, for the enhancement of activities of the uniformed services, for the guarding of the busy industrial process, plants, pits, and products. Organized to function in the interests of civilian protection in wartime they are designed to discourage and prevent destruction by saboteurs of our community facilities, and in case of enemy attack to quickly restore system and order out of chaos and confusion.

England learned the hard way. We can profit much from her experience during the last two years; however, the application of these lessons in each community is a problem unto itself. In many places one of the chief hurdles to overcome is that apathetic "it can't happen here" attitude of the general public. Engineers and contractors, you are leading citizens of your communities! It is up to you to change this lackadaisical attitude. Wars are contests based upon products of engineer's and contractor's skills. You are the ones best qualified to help overcome the suffering, the loss of life, and the confusion resulting from attacks upon our land by the engines and forces of destruction opposing those of your creation. It is not inferred here that these calamities are, even indirectly, your responsibility. What is stated means that inherently war is a contest of engineering production, and you are part of a group of those technical men best qualified to counteract the destructive efforts of like enemy groups. You owe it to your neighbor to take an active interest in your community defense council activities.

The writer, a field officer in the Coast Artillery Reserve, realizing that he has engineering and military qualifications useful to the state defense council has already taken action for community defense. He is ready to answer the call of the army on either construction or antiaircraft defense whenever his services are needed in uniform. Until that time arrives he serves the state council of defense as directed by the state coordinator. Many of his readers owe this same obligation to the members of their communities. Act now!

Selling Defense Bonds

AMERICAN victory in this war is not based upon raising a huge sum of money now and then contemplating that the fund so raised will do the job. It is based upon the question of raising immense sums week after week until victory is ours. Money is merely the token of labor. It takes labor, production to win a war. Hence, there is definite need for consistent loans, tokens of labor performed, to the government in the form of defense bonds and stamps.

The writer believes that the American people will purchase these bonds and stamps to the extent which their net incomes will allow. A plan for increasing the purchase of these defense bonds and stamps, which was suggested by Eugene W. Sloan, the Executive Director of the Defense Savings Staff, is for business executives to adopt a payroll allotment plan.

This idea is all right so long as freedom of action is allowed by the employee. The moment that compulsion, be it direct or indirect is employed, just that moment the payroll plan ceases to be an "American Way." To make the plan available is meritorious; to force it is reprehensible. The American people are intelligent. If they have funds with which defense bonds or stamps can be purchased, after they have provided for the necessities, they can be easily sold on the payroll allotment plan. That is the "American Way."

Defense—A Circle

FOREMOST amongst the minerals employed for defense of our institutions and the integrity of the western hemisphere is iron. Before we can have steel for shells, battleships, tanks, and guns the ore must be mined and hauled from the mine to the mill. Coal must be dug and hauled. Limestone must be quarried and transported. To keep these original producers going, they must be supplied with proper tools and equipment. Other industries must produce the power shovels, the trucks, the cars, the engines, the wire rope, the bolts, and the thousands of other items needed by the mines and quarries before the ingredients of iron can be collected at the furnaces.

While the above activities are progressing, airports and highways must be built, shipyards and camps erected, and powder plants, ammunition dumps, and shell loading plants constructed. Plant sites must be levelled off on which to erect the furnaces that will melt the ore, the mills that will roll ingots into shapes, the furnaces that will make the steel, and the factories that will fabricate the steel into tools and engines of defense. Transportation will be by rail and water as well as by highway. Power will have to be furnished to drive the mills. This means construction of dams and power houses and they mean construction of more roads. It seems that no matter what the type of construction may be, roads or streets are always involved as part of the building program.

All of these industries, and hundreds which have not been mentioned, must be operated by people. Manpower must be gathered and organized. People must live and eat, even as you and I. Their food must be fresh and good. Health must be guarded. Protection must be afforded. All of these, again, depend upon adequate road and street facilities. Where new towns are born and develop, entirely new street and highway construction is involved.

The food, eaten in the home, was hauled on the highway that was built by tools made of steel which was alloyed in a furnace fed by ore from a mine producing material for the defense of the nation and the man in the house eating the food hauled over the highway, etc. No matter how we view our handiwork, the result is always reflected as a circle of interrelated events. Always, one important link in these circular chains is the road or street. A view of our coordinated handiwork, whether gun carriages, bombs, highways, destroyers, or the more commonplace articles of civil life now acting a military role, shows us that National Defense is an effort which can be represented by a group of endless circular chains linked together by railroads, waterways, roads, streets, and airports. And we built that set of chains; let us see to it that the road and street links are adequate for the service to be demanded from them.

State Highway Construction

Reports from Highway Officials Showing Mileage Completed and Expenditures in 1940 and Probable Mileage and Expenditures in 1942

New England States

Maine

One of the principal items in the 1941 state highway construction program was the completion of 263 miles of gravel treated roads. Other items are shown in the tabulation.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$3,750,000.00
Bridge Construction	1,575,000.00
Grade Separation Construction	800,000.00
Maintenance	3,255,000.00
Equipment Purchases	

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	1
Bituminous Concrete	2
Bituminous Macadam	10
Bituminous, Low Cost	24
Gravel, Untreated	6
Gravel, Treated	263
Bridges (number)	30
Grade Separations (number)	1

MILEAGE OF STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Bituminous Concrete	1
Bituminous Macadam	5
Bituminous, Low Cost	24
Graded and Drained	8
Bridges (number)	41
Grade Separations (number)	2

The highway construction program for 1942 has not yet been determined.

New Hampshire

The approximate expenditures for the 1941 state highway program were $9,932,000. The estimated mileage of state highway construction for 1941 amounts to 112 miles.

Probable expenditures for 1942 are estimated at $7,434,000 and probable mileage at 85 miles.

Vermont

One of the principal items in the 1941 state highway construction program was the completion of 48 miles of gravel treated roads. Other items are shown in the tabulation.

STATE HIGHWAY EXPENDITURES

Approximate State Expenditures in 1941	
Highway Construction, Bridge Construction, Grade Separation Construction	$1,795,361.00
Maintenance	1,100,000.00
Equipment Purchases	62,500.00
Probable State Expenditures in 1942	
Highway Construction, Bridge Construction, Grade Separation Construction	$1,868,235.00
Maintenance	1,100,000.00

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	2
Bituminous Macadam	12
Bituminous, Low Cost	20
Gravel, Treated	48
Bridges (number)	8

MILEAGE OF STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Bituminous Macadam	5
Bituminous, Low Cost	5
Gravel Treated	17
Bridges	12

Information on the probable mileage of state highway construction for 1942 is not available at this time.

Massachusetts

The tables give information on the 1940 state highway department's construction program.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction, Bridge Construction, Grade Separation Construction	$4,578,407
Maintenance	3,438,897
Equipment Purchases	131,000
Probable Expenditures in 1942	
Highway Construction, Bridge Construction, Grade Separation Construction	$10,000,000
Maintenance	3,572,500
Equipment Purchases	192,700

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Bituminous Concrete	2
Bituminous Macadam	18
Bridges (number)	17
Grade Separations (number) R. R.	2
Grade Separations (number) Highway	7

MILEAGE OF STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	2
Bituminous Macadam	23
Bridges (number)	15
Grade Separations (number) R. R.	5
Grade Separations (number) Highway	2

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Brick	
Portland Cement Concrete	4
Bituminous Concrete	4
Bituminous Macadam	35
Bituminous, Low Cost	8
Bridges (number)	30
Grade Separations (number) R. R.	3
Grade Separations (number) Highway	3

Rhode Island

A total of 23 miles of highway construction and 5 bridges were completed under the 1941 program of the state highway department. Twelve of the 23 miles were portland cement concrete. The following tables show state highway construction in 1941 and the probable work for 1942.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$1,502,000
Bridge Construction	106,000
R. R. Grade Separation Construction	92,000
Maintenance	1,250,000
Equipment Purchases	150,000
Probable Expenditures in 1942	
Highway Construction	$1,120,000
Bridge Construction	440,000
R. R. Grade Separation Construction	240,000
Maintenance	1,265,000
Equipment Purchases	135,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	12
Bituminous Concrete	2
Bituminous Macadam	9
Bridges (number)	5
Grade Separations (number)	1

MILEAGE OF STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	3
Bituminous Concrete	2
Bituminous Macadam	3
Bridges (number)	1

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	6
Bridges (number)	4
Grade Separations (number)	1

Connecticut

The figures in the tables below are for the 1940-1941 fiscal year. None of these figures include administration.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1940-1941	
Highway Construction	$12,011,000*
Bridge and Grade Separation Construction	3,447,000
Maintenance	3,009,000**
Equipment Purchases	550,000

*Includes expenditures from state funds on town roads.

**Includes roadside and bridge maintenance and snow removal.

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1940-1941

	Miles (Estimate)
Portland Cement Concrete	34
Bituminous Concrete	4
Bituminous Macadam	34
Bituminous, Low Cost	15
Gravel, Untreated	60
Gravel, Treated	19
Graded and Drained	10
Bridges (number)	33
Grade Separations (number)	14

The above mileages include roads and structures built on town system with state funds.

Middle Atlantic States

New Jersey

The tables below give information on the 1941 state highway department's construction program and the probable program for 1942.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$6,116,898.82
Bridge Construction	3,657,438.60
Maintenance	3,597,859.14
Equipment Purchases	200,845.29
Probable Expenditures in 1942*	
Highway and Bridge Construction	$3,437,000.00
Maintenance	3,600,000.00
Equipment Purchases	200,000.00

* Carry over from 1941 only.

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Types	Miles (Estimate)
Portland Cement Concrete	51
Bituminous Concrete	1
Gravel, Treated	3
Graded and Drained	12

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

	Miles
Portland Cement Concrete	19
Bituminous Concrete	1
Gravel, Treated	4
Graded and Drained	6

The highway and bridge program for 1942 has not yet been determined.

Pennsylvania

The state highway department completed 2000 miles of highway construction, reconstruction, resurfacing, and surface widening during 1941.

The total state highway expenditures for the year 1941 were $78,000,000. $47,000,000 of this was expended for improvements and $31,000,000 for administration maintenance and operation.

South Atlantic States

Delaware

State highway expenditures for the fiscal year July 1, 1940, to June 30, 1941, included $2,318,000 for construction and $1,075,000 for maintenance.

Work completed in 1940 included 23 miles widening and 7 miles new pavement of portland cement concrete. Also completed during the fiscal year were 15 miles of bituminous macadam, 8 miles of bituminous concrete, 14 bridges, and two railroad crossing grade separations.

Macadam, Sur. Treated	106	2,360,303.00
Sh. Asph. & Bit. Conc.	30	669,270.00

Probable expenditures for 1942 are dependent on Federal appropriations and are, therefore, not available at this time.

Maryland

State highway expenditures in 1941 included $6,042,000 for highway construction and $845,000 for grade separation construction. The following tabulation summarizes the expenditures in 1941 and the probable expenditures in 1942.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$ 6,042,028.19
Bridge Construction	812,341.41
Grade Separation Construction	845,093.87
Maintenance — State and County	3,957,336.06
Miscellaneous	4,759,732.35*
Equipment Purchases	279,833.68

* Debt. Service, Balto. City, Purchase of Ferry (1941), etc.

Probable Expenditures in 1942	
Highway and Bridge Construction	$12,169,000.00
Grade Separation Construction	353,000.00*
Maintenance — State and County	4,261,000.00
Miscellaneous	5,000,000.00
Equipment Purchases	415,000.00

* From Federal Grade Funds only.
** Exclusive of Access and Strategic Roads to be constructed by Federal Appropriations.

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	41
Bituminous Concrete and Macadam	9
Bituminous, Low Cost	46
Gravel, Untreated	31
Bridges and Grade Separations (Number)	29

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	76
Bituminous Concrete and Macadam	11
Bituminous, Low Cost	20
Gravel, Untreated	20
Bridges and Grade Separations (Number)	32

Virginia

During the calendar year 1941 this Department advertised and awarded 122 road and bridge contracts, amounting to approximately $12,316,000. In addition, 22 convict labor construction projects, involving approximately $3,508,000 were authorized along with 72 miscellaneous projects totaling approximately $2,088,000, making a grand total for construction put under way in 1941 of $17,913,000.

STATE HIGHWAY CONSTRUCTION
Work Completed During Calendar Year of 1941

	Miles	Cost
Graded and Drained	55	$ 869,227.00
Soil, Gravel, untreated	23	389,649.00
Soil, Gravel, Sur. Treated	74	815,362.00
Macadam, untreated	8	174,076.00
P. C. Concrete	3	277,800.00
Total New Const.	300	$5,555,687.00
Bridges	48	$2,213,000.00
Grade Separations	5	76,000.00
Flash Light Signals	1	4,000.00
Widening		
Macadam, Sur. Tr.	38	$ 550,230.00
Sh. Asph. & Bit. Conc.	9	360,956.00
P. C. Concrete	43	1,453,466.00
Dual Type	16	736,591.00
TOTAL WIDENING	105	$3,101,243.00
Structures Widened		
Bridges	24	$257,000.00
Grade Separations	2	43,000.00
Total Structures Widened	26	$300,000.00

Incomplete Work Carried Over into Calendar Year 1942

	Miles	Cost
Graded and Drained	31	$ 686,889.00
Soil, Gravel, untreated	6	48,660.00
Soil, Gravel, Sur. Treated	26	326,800.00
Macadam, Untreated	5	79,600.00
Macadam, Sur. Treated	116	2,719,786.00
Sh. Asph. & Bit. Conc.	4	175,642.00
Portland Cement Conc.	3	306,936.00
	192	$4,344,313.00
Bridges	17	$1,042,000.00
Grade Separations	1	110,000.00
Flash Light Signals	1	6,000.00
Widening		
Macadam, Sur. Tr.	24	$ 727,389.00
Sh. Asph. & Bit. Conc.	4	249,714.00
P. C. Concrete	7	465,073.00
TOTAL WIDENING	35	$1,442,176.00
Structures Widened		
Bridges	10	$325,000.00
Grade Separations	1	38,000.00
Total Structures Widened	11	$363,000.00

Probable New Construction in 1942

	Miles	Cost (Estimate)
Graded and Drained	121	$1,721,000.00
Soil, Gravel, Untreated	3	283,068.00
Soil, Gravel, Sur. Treated	53	2,415,700.00
Macadam, Untreated		643,993.00
Macadam, Sur. Treated	169	4,426,544.00
Sh. Asph. & Bit. Conc.	10	180,000.00
Portland Cement Conc.	1	50,000.00
	354	$9,720,305.00
Bridges	40	$2,560,000.00
Grade Separations	4	185,000.00
Flash Light Signals	2	600,000.00
Widening		
Macadam, Sur. Tr.	27	$ 727,000.00
P. C. Concrete	55	1,785,000.00
Dual Type	6	386,000.00
TOTAL WIDENING	88	$2,898,000.00
Structures Widened		
Bridges	11	$215,000.00

GRAND TOTAL COST

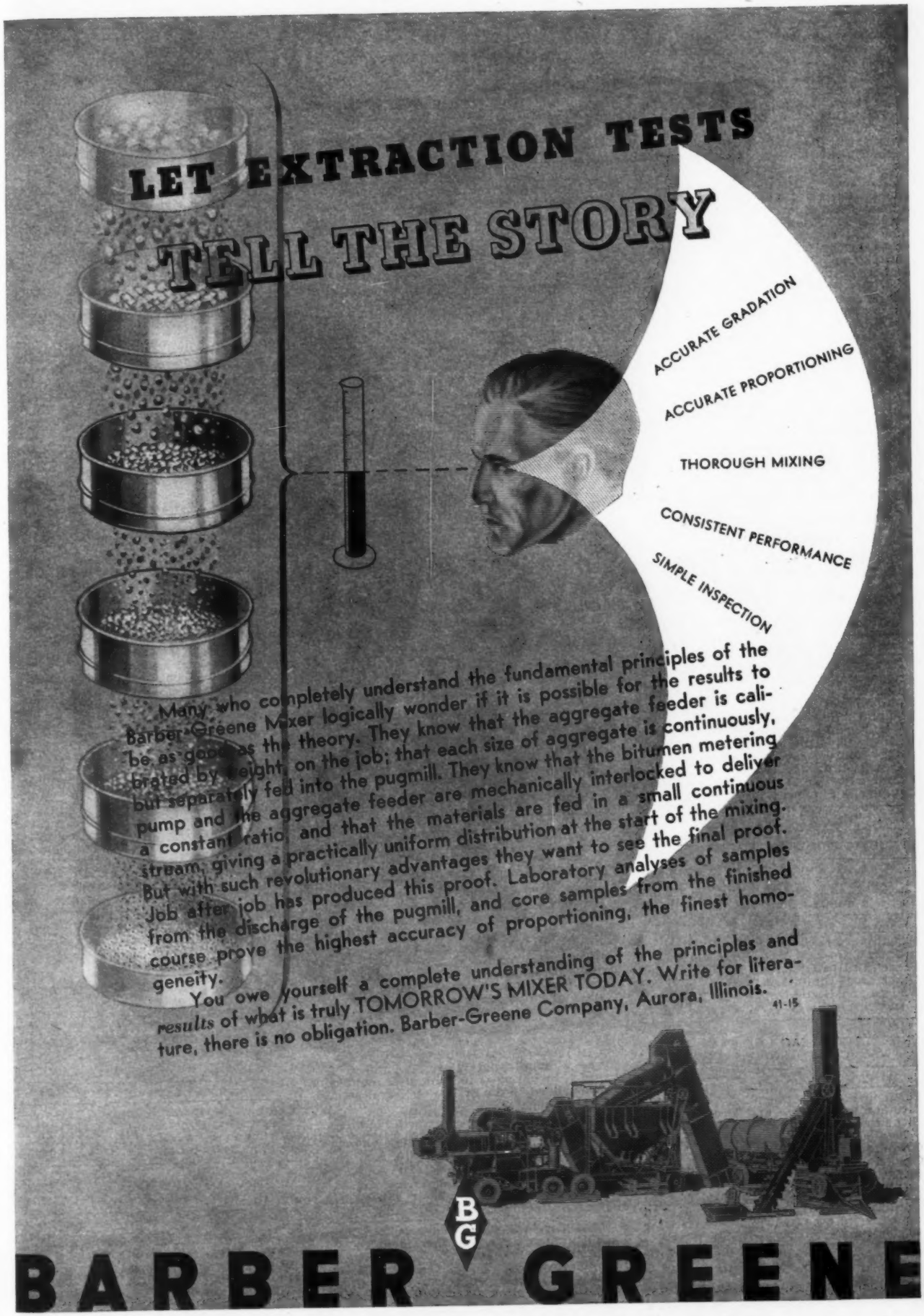
1941 Work	$11,251,000.00
Carried Over	7,308,000.00
New 1942 Work	15,585,000.00

NET FUNDS AVAILABLE FISCAL YEAR JULY 1, 1942 TO JULY 1, 1943

Primary Construction, Including Federal Aid	$15,000,000.00
Primary Maintenance	3,181,795.00
Grade Crossing Construction	375,157.00
Primary Improvements	2,818,205.00
Primary Maintenance City Streets	678,000.00
	$23,053,157.00
Secondary Maintenance, Construction and Improvements	8,500,000.00

(Federal Aid available, included in above Primary Construction figures, $2,543,000.00.)

In 1941 approximately $210,000 was expended for new equipment and replace-


LET EXTRACTION TESTS
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Many who completely understand the fundamental principles of the Barber-Greene Mixer logically wonder if it is possible for the results to be as good as the theory. They know that the aggregate feeder is calibrated by weight on the job; that each size of aggregate is continuously, but separately fed into the pugmill. They know that the bitumen metering pump and the aggregate feeder are mechanically interlocked to deliver a constant ratio, and that the materials are fed in a small continuous stream, giving a practically uniform distribution at the start of the mixing. But with such revolutionary advantages they want to see the final proof. Job after job has produced this proof. Laboratory analyses of samples from the discharge of the pugmill, and core samples from the finished course prove the highest accuracy of proportioning, the finest homogeneity.
You owe yourself a complete understanding of the principles and *results* of what is truly TOMORROW'S MIXER TODAY. Write for literature, there is no obligation. Barber-Greene Company, Aurora, Illinois.
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ments. In 1942 an outlay of $340,000 for new equipment and replacements is recommended, which is included in the cost of maintaining and improving highways.

Studies, plans and estimates involving approximately $8,700,000 on access roads have been tentatively made and are awaiting allocation of recent appropriation for this purpose, the majority of which will be in the Hampton Roads area. At this time it is not known exactly what Virginia will receive.

The most outstanding project completed during 1941 was the Riverton bridge work which eliminated structures erected in 1894 and long since obsolete. The next largest was the Rappahannock River bridge on Route 3 at Fredericksburg. The Occoquan River bridge on Route 1 north of Fredericksburg and New River—N. & W. Railway bridge on Route 8 near Narrows were marked for completion but will be carried over into 1942 due to failure to obtain the necessary materials for construction.

In the 1942-43 allocations first consideration is given to improvement of those roads which have been determined by the Army and Navy to be of primary strategic importance in National defense. It is also pointed out that for the coming year that construction outlined is predicated on the continuation of normal civilian traffic. Any curtailment of traffic will reduce the available construction funds and make necessary changes in types, lengths or locations of proposed work.

West Virginia

State highway expenditures for the 1941 program totaled $15,100,000. Probable expenditures for 1942 is set at $16,265,000. Details are tabulated below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$7,500,000
Bridge and Grade Separation Construction	1,100,000
Maintenance	5,500,000
Equipment Purchases	1,000,000
Probable Expenditures in 1942	
Highway Construction	$8,565,000
Bridge and Grade Separation Construction	1,200,000
Maintenance	5,500,000
Equipment Purchases	1,000,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

	Miles (Estimate)
Portland Cement Concrete	15
Bituminous Concrete	21
Bituminous Macadam	16
Bituminous, Low Cost and Gravel, Treated	571
Gravel, Untreated	63
Graded and Drained	66
Bridges and Grade Separations (number)	20

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	19
Bituminous Concrete and Macadam	31
Bituminous, Low Cost and Gravel, Treated	600
Gravel, Untreated	150
Graded and Drained	768
Bridges and Grade Separations (number)	25

Information regarding uncompleted work carried over to 1942 is not available at this time.

North Carolina

Of the total $22,400,000 expenditures by the state highway department during 1941, $11,500,000 was expended for maintenance. Details are given in the tables.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction (by contract)	$ 7,700,000.00
Bridge and Grade Separation Construction	2,300,000.00
Maintenance	11,500,000.00
Equipment Purchases	900,000.00
Probable Expenditures in 1942	
Highway Construction	$ 8,000,000
Bridge and Grade Separation Construction	2,000,000
Maintenance	12,000,000
Equipment Purchases	950,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

	Miles (Estimate)
Portland Cement Concrete	95
Portland Cement Concrete Widening	68
Sand Asphalt Surfacing and Widening	94
Gravel, Untreated	1
Gravel, Sand Clay and Crushed Stone	167
Graded and Drained	75
Bridges and Grade Separations (number)	47

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

	Miles
Portland Cement Concrete	29
Gravel, Untreated	7
Gravel, Sand Clay and Crushed Stone	102
Graded and Drained	47
Bridges and Grade Separations (number)	17

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	75
Portland Cement Concrete Widening	100
Sand Asphalt Surfacing and Widening	75
Gravel, Sand Clay and Crushed Stone Treated	200
Graded and Drained	50
Bridges (number) / Grade Separations (number)	30

South Carolina

During the calendar year 1941 the State Highway Department awarded construction contracts for road and bridge projects aggregating $8,430,000.

These contracts included approximately 22,000 feet of bridge work and five underpasses; 293 miles of earth road construction preparatory to hard surfacing; 174 miles of bituminous surface treatment; and 22 miles of concrete pavement.

Estimated expenditures during the year amounted to $9,500,000. At the end of 1941 the State Highway System embraced approximately 10,775 miles of roads, including 1,100 miles of county roads added to the State Highway System in December.

The mileage by types of the 9,675 miles on the State Highway System on October 31, 1941 (prior to the time 1,100 miles of county roads were added) was as follows:

Type	Miles
Hard Surfacing	
Standard High Type Pavements	2,639
Bituminous Surface Treatment	4,234
Improved Earth Types	288
Unimproved	2,514

Maintenance expenditures for the fiscal year ending June 30, 1941, were as follows:

Direct Cost of Maintenance	$2,093,000*
Retreatment	933,000
Shoulder Treatment	249,000
Special Maintenance	8,000
Purchase of New Equipment	553,000

*This includes labor, materials and supplies, operation of draw bridges and supervision.

Given below are the receipts and expenditures of the State Highway Department for the fiscal year 1940-1941:

RECEIPTS

Gasoline Tax (5c)	$12,147,000
Motor Vehicle Fees	2,392,000
Federal Aid	1,963,000
Bond Sales	5,515,000
Others	31,000
Total	$22,048,000

EXPENDITURES

Administration, and Collection of Revenue	$ 386,000
Construction	8,703,000
Maintenance	3,836,000
Funded Debt (Pr. & Int.)	6,933,000
Law Enforcement	741,000
Others	204,000
Total	$20,803,000

It is expected that during the coming calendar year, the Highway Department will carry out construction contracts for access roads and other defense projects as required by the Federal Government. These projects will, of course, be given first priority. The amount of Federal funds which will be available for access road projects has not yet been determined, but in view of the number of training centers in the State it is expected the amount of funds allocated for these projects will be considerable.

Maintenance expenditures and other expenditures for operation of the Department will be about the same for 1942 as for 1941. An additional 1,100 miles of roads will be added to the State Highway System in 1942.

Georgia

State highway expenditures in 1941 included $15,604,000 for construction and $1,422,000 for maintenance.

Work completed in 1941 included 78 miles of graded roads, 49 miles of untreated gravel, 141 miles of treated gravel, 32 miles of high type bituminous surfacing, and 37 miles of concrete. Other features of the 1941 program were the completion of 43 bridges and the improvement of 7 miles of roadside.

The program for 1942 is, as yet, undetermined due to the present uncertain conditions.

Florida

A total of 542 miles of highway construction, 31 bridges, and 3 grade separations were completed by the state highway department during the 1941 program. Details are given below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway, Bridge and Grade Separation Construction	$11,381,191.82
Maintenance	3,721,431.16
Equipment Purchases	425,023.75

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	22
Bituminous, Low Cost	447
Graded and Drained	39
Bridges (number)	31
Grade Separations (number)	3

Buckeyes *Take It As It Comes!*

W. Wells Engr. Co's. Model digs 24" by 4' trench for er main, Saginaw, Mich., at of 50' per hr.; undercuts and driveways; spoil loadnto trucks.

Model 120 digs trench up to 30" by 11½'. Long Beach, (Cal.) Water Dept. benefits by its ability to undercut existing crude oil and gas lines. Digs effectively forward or reverse.

Contractors dig trench at the lowest possible cost with Buckeye Service Trenchers because they take any job as it comes — sand, clay, mud, gravel, or what have you. Big and rugged enough for long, gruelling service, they are nevertheless readily maneuvered.

The Models 160 and 120 shown have shiftable booms to left or right, for digging close to foundations, curbs and for getting around obstructions. And it's easy to cut a curve and hold to grade with a Buckeye. The urgency of today's trenching jobs require the speed only Buckeyes can give you.

There's a Buckeye Trencher for every class of work — 18 models in the line — chain-bucket and rotary wheel types — utility machines for trench 15" wide by 6' deep up to the heavy duty units for trench 12' wide by 24' deep.

BUCKEYE TRACTION DITCHER CO.
FINDLAY, OHIO

Model 160 (unposed) digs big boulder out of sewer pipe trench at Washington, D. C. The 160 makes trench up to 36" wide by 15' deep.

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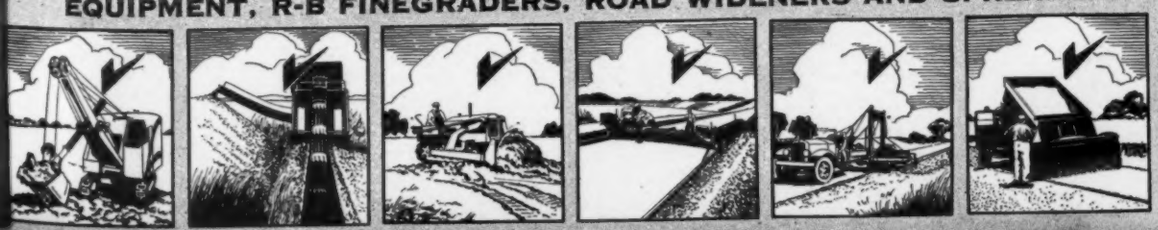

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STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	18
Bituminous, Low Cost	217
Graded and Drained	88
Bridges (number)	30
Grade Separations (number)	2

The state highway department have not as yet formulated the 1942 program, therefore, details of mileage under construction and future expenditures are not available.

East North Central States

Ohio

The total state highway expenditures for 1941 were approximately $17,219,000. This program included construction, reconstruction, and surface treatment on 2511 miles. The probable expenditures for 1942 are somewhat indefinite and will depend on available funds. However, it is estimated that contract work will equal or exceed 1941.

Indiana

The following information on state highway expenditures in 1941 is based on the fiscal year ended June 30, 1941:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$10,815,603.51
Bridge Construction	3,328,559.98
Maintenance	4,500,000.00
Equipment Purchases	278,970.41
Probable Expenditures in 1942	
Highway Construction	$14,000,000.00
Bridge Construction	4,000,000.00
Maintenance	4,500,000.00
Equipment Purchases	200,000.00

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	124
Bituminous Concrete—Surfacing	135
Bituminous, Macadam	47
Bituminous, Low Cost	504
Gravel, Untreated	30
Gravel, Treated	57
Graded and Drained	102
Bridges (number)	87
Rock Asphalt—Surfacing	251

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	114
Bituminous Concrete—Surfacing	26
Bituminous Macadam	71
Bituminous, Low Cost	15
Gravel, Untreated	40
Gravel, Treated	16
Graded and Drained	10
Bridges (number)	78

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	130
Rock Asphalt—Surfacing	130
Bituminous, Low Cost	100
Graded and Drained	90
Bridges (number)	100

Illinois

Reports from the state highway department show that approximately $24,470,000 will be expended in their 1941 construction program. Of this amount $17,298,000 is estimated as highway construction, and bridge and grade separation construction. Probable expenditures for 1942 are indefinite and are therefore not given. The following tabulations give details of 1941 work.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$14,925,936.15
Bridge Construction	1,011,746.46
Grade Separation Construction	1,360,890.15
Maintenance	6,132,028.21
Equipment Purchases	1,040,255.10

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	122
Bituminous Concrete and Sheet Asphalt	49
Bituminous Surfaces	33
Bituminous Seal Coats	61
Gravel, Untreated	13
Gravel, Treated	100
Graded and Drained	66
Bridges (Number)	47
Grade Separations (Number)	13

The probable mileage of state highway construction for 1942 is as yet indefinite.

Michigan

Approximate expenditures for highway construction for 1941 total $22,927,000. Probable expenditures for 1942 cannot be estimated at this time because of the concentration on surveys, plans and construction projects which are certified as vital to the national defense. This type of work will consist of concrete pavement, grade separations and bridges. A major military reservation access road project is at Fort Custer where $800,000 of concrete pavement, grade separation and bridge construction remains to be completed. The following statistics give some details of the state highway construction work accomplished for 1941.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Road Construction	$13,098,309.00
Bridges and Grade Separations	2,687,170.00*
Maintenance and Traffic Service	6,892,000.00
Equipment Purchases (estimated)	250,000.00

* Includes right of way and engineering.

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Brick	2
Concrete	58
Bituminous Concrete and Sheet Asphalt	10
Low Cost Bituminous	160
Treated Gravel	68
Graded and Drained	10
Bridges	46
Grade Separations	7

Wisconsin

A total of 923 miles of highway construction was completed under the 1941 state highway department program. Of this total, 486 miles were bituminous surfacing. Various other items are shown in the tabulation given below.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Construction	$9,500,000
Maintenance	4,500,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	79
Bituminous Surfacing	486*
Gravel or Crushed Stone	222
Graded and Drained	136
Structures (value)	$1,900,000
Grade Separations (number)	4

* Includes Detours and State Park Roads.

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	20
Bituminous Surfacing	52
Gravel or Crushed Stone	120
Graded and Drained	39
Structures (value)	$1,100,000
Grade Separations (number)	2

Details of the 1942 construction program are not yet available.

East South Central States

Kentucky

The total state highway expenditures for 1941 were $15,290,000. The mileage of highway construction placed under contract amounted to 621 miles. Details of 1941 expenditures and mileage are given below:

STATE HIGHWAY EXPENDITURES CONSTRUCTION
(Placed under contract)

Type	Amount
Rigid Type Pavement	$ 3,120,000
Bit. Mat on Existing Earth, Gravel or Stone Road Bed	2,144,000
Calcium Chloride Clay-Gravel Type	191,000
Bit. Surface Treatment on Earth, Gravel or Stone Road Bed	180,000
Gravel or Stone Surfacing	1,739,000
Grading (incl. Culverts & Small Bridges)	1,445,000
Bridges and Culverts	2,750,000
R. R. Grade Separations	815,000
Bit. Concrete—Non-Rigid	1,860,000
Rock Asphalt	832,000
Rock Asphalt Surface Seal	125,000
Roadside Improvement	88,000
Total Expenditures	$15,290,000
MAINTENANCE	
Maintenance Proper	$ 5,509,000
Betterments	467,000
Total	$ 5,976,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION
(Placed under contract)

Type	Miles
Rigid Type Pavement (26)	82
Bit. Mat on Existing Earth, Gravel or Stone Road Bed (27)*	220
Calcium Chloride Clay-Gravel Type	28
Bit. Surface Treatment on Earth, Gravel or Stone Road Bed	21
Gravel or Stone Surfacing (72)*	83
Grading (incl. Culverts & Small Bridges)	45
Bridges and Culverts (number)	19
R. R. Grade Separations (number)	8
Bit. Concrete—Non-Rigid (29)*	70
Rock Asphalt (12)*	56
Rock Asphalt Surface Seal	18
Roadside Improvement (33)	..
Total Mileage (166.184)*	623

*Graded in conjunction with surfacing and included with miles for types.

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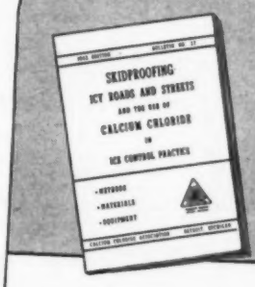

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Tennessee

Federal funds allocated along with state highway funds will provide approximately $6,355,000 for the 1942 state highway program.

The following projects have been planned: 84 miles of grading, drainage, and bridges; 12 miles of grading and paving; 63 miles of surfacing; 6 bridges and approaches; 3 grade elimination projects; and 2 overheads and approaches.

In conjunction with the W.P.A. there has been scheduled a $4,000,000 program in construction, consisting of 257 miles of base, surface, and widening, and 48 miles of widening, grades, and rocking shoulders.

Prison labor projects have also been planned, involving $1,340,000 in construction. This work will include 149 miles of base, surfacing, and widening and 48 miles of widening, grades, and rock shoulders.

The maintenance program for 1942 involves an expenditure of $1,800,000 for labor and materials and $650,000 for equipment rental. There has also been allotted $400,000 for the purchase of new equipment.

The above plans are subject to adjustment due to the defense emergency. The 1943 Federal allotments have not as yet been made and are not included in the above estimates.

Alabama

The state highway department operates on a fiscal year policy which ends on September 30, of each year. The tables given below are based on this policy.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$8,963,510
Maintenance	2,572,979
Equipment Purchases	259,478

The above total of $11,796,000 is the cost to the state highway department for the major items explained, which are included in the total expenditure by the highway department of $17,140,000 for the fiscal year ending September 30, 1941. Other major items of expense were bond retirements, interest, administration, and miscellaneous.

Probable Expenditures for 1942	
Highway Construction (Of which some $2,000,000 was anticipated to have been spent on bridge projects including grade separations, etc.)	$14,784,000
Highway Maintenance	2,300,000
Purchase of Equipment	400,000

SUMMARY OF CONSTRUCTION ACTIVITIES FISCAL YEAR ENDING SEPTEMBER 30, 1941

Type	Miles (Estimate)
Grade Drain	409
Temporary Surface	50
Base Course	399
Bituminous Prime Coat	436
Bituminous Mat	455
Bituminous Seal Coat	442
Bridges	8

On October 1, 1941, the state highway department had under construction approximately 150 miles of bituminous paving. This pavement will be completed during the year 1942. The state highway program for 1942 is planning to construct an additional 500 miles or complete a total of 650 miles of bituminous pavement. Also included in this program is the completion of additional mileage of gravel, graded, and drained roads, in addition to a normal bridge building and grade separation program.

The 1942 state highway program may be revised, due to the national emergency and the all-out defense effort.

Mississippi

The approximate expenditures for the 1941 highway program, up to and including December 9, 1941, are given in the tabulation below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$6,590,902
Bridge Construction	1,063,858
Grade Separation Construction	345,240
Maintenance	1,850,000
Equipment Purchases	250,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	83
Bituminous Concrete	1
Sand Asphalt	60
Bituminous, Low Cost	226
Gravel, Untreated	102
Graded and Drained	117
Drainage Structures (number)	62
Over-pass (number)	6
Under-pass (number)	1

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	19
Sand Asphalt	68
Bituminous, Low Cost	34
Gravel, Untreated	16
Graded and Drained	103
Bridges (number)	40
Grade Separations (number)	4

The 1942 state highway program is as yet undetermined.

West North Central States

Minnesota

The approximate expenditures for the 1941 highway program by the state highway department listed below do not include the month of December.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$9,090,607
Bridge Construction	1,152,210
Grade Separation Construction	179,739
Maintenance	6,800,000
Equipment Purchases	700,000
Probable Expenditures in 1942	
Maintenance	$7,000,000
Equipment Purchases	260,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimated)
Portland Cement Concrete	108.8
Bituminous, Low Cost	277.9
Gravel, Untreated	127.3
Gravel, Treated	388.5
Graded and Drained	440.3
Bridges (number)	26
Grade Separations (number)	10

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	10.7
Bituminous, Low Cost	91.6
Gravel, Untreated	125.9
Gravel, Treated	209.6
Graded and Drained	165.9
Bridges (number)	21
Grade Separations (number)	10

The state highway department has not as yet formulated the 1942 program because of the present uncertainty due to national defense. Therefore, the details of mileage to be put under construction are not available.

Iowa

The approximate expenditures for the 1941 highway program by the state highway department include the months from December 1, 1940 to December 1, 1941.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$3,536,736
Bridge Construction	661,066
Grade Separation Construction	524,000
Maintenance	4,191,271
Equipment Purchases	120,523

The probable expenditures in 1942 will be similar to those in 1941.

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimated)
Portland Cement Concrete	99.37
Bituminous Macadam	0.00
Bituminous, Low Cost	46.10
Gravel, Untreated	535.06
Graded and Drained	415.00
Bridges (number)	87
Grade Separations (number)	6

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

Type	Miles
Portland Cement Concrete	28
Bituminous, Low Cost	25
Gravel, Untreated	263
Graded and Drained	161
Bridges (number)	54
Grade Separations (number)	6

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	100
Bituminous, Low Cost	70
Gravel, Untreated	300
Gravel, Treated	50
Graded and Drained	500
Bridges (number)	100*
Grade Separations (number)	Several

* From 14 span up.

The expenditures shown are cash expended only and do not take into account money due contractors on estimates for work accomplished. There is probably a million or more in cash due on contracts carried over and on estimates pending.

Missouri

During 1941 the Missouri State Highway Commission used its construction funds for the most part in the modernization by reconstruction and other improvement of the existing state highway system, and for the extension of the farm-to-market roads. Much of this work was made up of converting the lower traffic gravel roads into roads of dustless surface, and the construction and improvement of the roads of the state which carry the high traffic volumes. Most of the roads in the last category are those that have an importance as military roads and are otherwise considered strategically important to the national defense.

The highway system of Missouri now comprises approximately 16,000 road miles, an increase of 175 road miles over the figures for the same date of 1940. This increase required the construction of a much higher construction mileage as indicated in the tabulation below.

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STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$11,481,000
Bridge Construction	1,343,000
Grade Separation Construction	1,108,000
Probable Expenditures in 1942	
Concrete Pavement	$10,280,000
Bituminous Surface	870,000
Oil-Aggregate Surface	750,000
Granular Surface	1,100,000
Graded Earth	500,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Concrete Pavement	133
Bituminous Surface	78
Oil-Aggregate Surface	568
Granular Surface	206
Graded Earth	46

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Concrete Pavement	165
Bituminous Surface	50
Oil-Aggregate Surface	620
Granular Surface	200
Graded Earth	40

The State of Missouri is operating on a pay-as-you-go plan, and the state revenue for 1941 will be about $1,500,000 more than for 1940. Sufficient funds have been available to match all federal allotments. Heavy bond requirements and a maintenance allotment of approximately $6,500,000 have been taken care of and the Department goes into the year 1942 in a satisfactory financial condition. The estimates of receipts from state sources, principally gas tax and license fees, for 1942, will be estimated at the actual income for 1941, although there is a feeling that the restriction in the manufacture of automobiles and the possibility of a reduction in the gas tax collections, will have to be taken into account.

The regular federal aid for 1942 remains at about the same figure as for 1941, and the additional federal aid for Missouri is not definitely known at this time. It is confidently believed that the Missouri Department will be able to provide all funds necessary for the matching of any federal allotment likely to be made to the State. It is also believed that all roads vitally necessary for national defense, and suggested by the federal government, can be constructed in due time.

North Dakota

The following tabulations give some details of the state highway construction for work accomplished in 1941.

STATE HIGHWAY EXPENDITURES

(Approximate Expenditures in 1941	
Highway Construction	$3,559,900
Bridge Construction	185,550
Grade Separation Construction	560,141
Maintenance	1,584,845
Equipment Purchases	174,150

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	2
Bituminous, Low Cost	210
Graded and Drained	3
Bridges (number)	9
Grade Separations (number)	2

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Bituminous, Low Cost	66
Graded and Drained	16
Bridges (number)	6
Grade Separations (number)	2

Probable expenditures and mileage for 1942 are uncertain because of present war conditions.

South Dakota

The tables given below supply information on the 1941 state highway department's construction program and the probable construction program for 1942.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$3,300,000
Bridge Construction	480,000
Grade Separation Construction	30,000
Maintenance	2,000,000
Equipment Purchases, Bldgs., etc.	120,000
Probable Expenditures in 1942	
Highway Construction	$3,500,000
Bridge Construction	400,000
Grade Separation Construction	200,000
Maintenance	2,250,000
Equipment Purchases, Bldgs., etc.	125,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	8
Bituminous, Low Cost*	222
Gravel, Untreated	109
Gravel, Treated (stabilized)	165
Graded and Drained	261
Bridges (number)	75
Grade Separations (number)	2
Flashing Light Signals (number)	10

* Inclusive of all types.

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

Type	Miles
Bituminous, Low Cost*	180
Gravel, Untreated	21
Gravel, Treated (stabilized)	177
Graded and Drained	68
Bridges (number)	15

* Inclusive of all types.

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete	20
Bituminous, Low Cost	260
Gravel, Untreated	120
Gravel, Treated	126
Graded and Drained	175
Bridges (number)	60
Grade Separations (number)	2
Flashing Light Signals (number)	12

The estimate and probable highway construction plans for 1942 are only tentative and may be changed in view of the present emergency.

Nebraska

The total estimated state highway expenditures in 1941 were $6,500,000. The mileage of highway construction completed during 1941 is given below.

	Miles
Grading	222
Gravel	173
Bituminous Surfacing	170
Concrete Pavement	24
Bridges	81
Railroad Grade Separations	7
Traffic Signal Installations	5
Railroad Crossing Signal Installations	9

The highway construction program for 1942 is very indefinite and not available at this time.

Kansas

State highway expenditures for the 1941 program totaled $11,878,000. Probable expenditures for 1942 is set at $17,122,000. Details are tabulated below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction, including Bridges and Grade Separations	$7,730,000
Maintenance, including Equipment Operation	3,873,000
Equipment Purchases	275,000
Probable Expenditures in 1942	
Highway Construction, including Bridges and Grade Separations	$12,750,000
Maintenance, including Equipment Operation	4,079,000
Equipment Purchases	292,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete	17
Bituminous, Low Cost	518
Gravel, Untreated	208
Graded and Drained	239
Bridges (number)	69
Grade Separations (number)	7

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

	Miles
Portland Cement Concrete	43
Bituminous, Low Cost	146
Gravel, Untreated	184
Graded and Drained	292
Bridges (number)	123
Grade Separations (number)	4

The probable mileage of state highway construction for 1942 has not yet been determined.

West South Central States

Arkansas

The construction program for the 1941 calendar year aggregated contract commitments in the amount of $3,078,000 and involved the following classifications of work:

	Miles
High Type Pavement	6
Bituminous Surfacing, Road Mix or Equivalent	101
Untreated Gravel Surfacing	32
Grading and Minor Drainage Structures	25
Major Bridges	5,746
Railroad-Highway Overpass Structures (number)	2
Railroad-Highway Underpass Structures (number)	2
Railroad Crossing Protection Devies (number)	12

Funds from Federal sources amounted to $2,258,000 of the whole, and those from State sources to $320,000.

In addition to the above, cooperative work with the Work Projects Administration was placed under agreement involving expenditures or commitments in the amount of about $360,000 on the part of the State. This work generally consisted of grading, drainage structures, un-

treated gravel surfacing, treated gravel surfacing, base courses and bituminous surfacing.

Information regarding the 1942 state highway program is not available at this time.

Louisiana

The Statewide Highway Project sponsored by the Department of Highways in cooperation with the Federal Works Projects Administration now has $2,300,000 worth of projects under construction. This work consists of grading and gravel surfacing; new bituminous surface treatment; roadside improvement and the resealing of old bituminous surface treatment.

In addition to the above WPA program, the Department of Highways has under construction $2,900,000 worth of access roads leading to and connecting the Army camps in Louisiana. This work consists of widening present embankment; construction of gravel base with 2 in. asphaltic concrete wearing course.

The maintenance section of the department has reconstructed 18 miles of bituminous surface treated access highways around the Army camps at a cost of $95,000.

Progress has also been made in the improvement of the farm to market road system. During 1941 $850,000 was spent in resurfacing gravel roads and reconditioning bridges. Approximately 170 miles of surface treated highways were reconditioned at a cost of $551,000, in addition to routine maintenance. Details of the 1941 work and new work for 1942 are given below:

WORK PERFORMED 1941

Type	Miles	Amount
Concrete	73.0	$3,153,860.80
Surf. Treat.	41.0	510,878.46
Agg. Surf.	120.0	1,446,129.76
Grading	60.0	512,182.76
Bridges	...	2,989,798.97
Grade Sep.	0.6	329,790.00
Rdside Imp.	52.0	591,960.00
Bit. Pavt.	26.0	609,399.25
Totals	372.6	$10,144,000.00

RECONDITIONING

Surf. Treat.	170.0	$ 551,607.00
Agg. Surf.	390.0	685,600.00
Bridges	...	171,873.00
Rdside Imp.	70.0	54,360.00
Bit. Pavt.	2.0	20,000.00
Totals	632.0	$1,483,440.00

STATE AID TO PARISHES
(Reconditioning)

Agg. Surf.	590.0	$ 235,844.00
Bridges	...	7,100.00
Totals	590.0	$ 242,944.00

FORWARD TO 1942

Type	Miles	Amount
Concrete	25.0	$1,553,882.25
Surf. Treat.	57.0	959,935.41
Agg. Surf.	107.0	853,040.37
Grading	13.0	539,058.85
Bridges	...	2,835,975.10
Grade Sep.	...	.....
Rdside Imp.	45.0	417,808.28
Bit. Pavt.	101.0	2,689,801.74
Totals	348.0	$9,849,502.00

RECONDITIONING

Surf. Treat.	147.0	$1,833,545.76
Agg. Surf.	752.0	2,118,924.17
Bridges	...	148,781.38
Rdside Imp.	8.0	6,064.87
Bit. Pavt.	4.3	43,053.82
Totals	911.3	$4,150,370.00

STATE AID TO PARISHES
(Reconditioning)

Agg. Surf.	1388.0	$ 586,674.95
Bridges	...	90,153.05
Totals	1388.0	$ 676,828.00

NEW WORK 1942

Type	Miles	Amount
Concrete	35.0	$1,600,000.00
Surf. Treat.	45.0	900,000.00
Agg. Surf.	100.0	1,000,000.00
Grading	60.0	950,000.00
Bridges	...	1,286,000.00
Grade Sep.	...	1,317,000.00
Rdside Imp.	25.0	207,000.00
Bit. Pavt.	20.0	180,000.00
Totals	285.0	$7,440,000.00

RECONDITIONING

Surf. Treat.	300.0	$1,200,000.00
Agg. Surf.	750.0	1,125,000.00
Bridges	...	300,000.00
Rdside Imp.	50.0	75,000.00
Bit. Pavt.	30.0	250,000.00
Totals	1130.0	$2,950,000.00

STATE AID TO PARISHES
(Reconditioning)

Agg. Surf.	1400.0	$ 600,000.00
Bridges	...	.....
Totals	1400.0	$ 600,000.00

GRAND TOTAL COST

Work Performed 1941	$11,870,000.00
Forward to 1942	14,677,000.00
New Work 1942	10,990,000.040

FUNDS AVAILABLE 1942

F. A. (Regular)	$ 4,889,000.00
F. A. (Secondary)	608,000.00
F. A. (Grade Sep.)	1,746,700.00
Flood Control	5,000,000.00
Flood Relief	115,000.00
Access Funds	2,500,000.00
W.P.A. Reg.	2,000,000.00
W.P.A. Access	2,550,000.00
Forest Highway Funds	58,000.00
*Motor Tax (Net)	9,300,000.00
Bond	1,400,000.00
Total	$30,166,700.00

*Bond Redemption not included.

DISBURSEMENTS 1942

Construction	$17,289,502.00
Reconditioning	7,100,370.00
State Aid to Parishes	1,276,828.00
Maintenance	4,000,000.00
Equipment	500,000.00
Total	$30,166,700.00

Funds for new construction for the year 1942 are estimated at $7,400,000; the value of all work that will be carried forward to 1942 is $14,600,000 and available funds for reconditioning and farm to market roads is estimated at $3,600,000 making a total of $25,600,000 for highway construction, reconditioning and farm to market roads. Of this total, Federal funds are available as follows:

$5,000,000 for the construction of bridges and approaches in the floodway area.

$7,000,000 Regular Federal-aid for construction of roads, bridges and grade eliminations on strategic network.

$2,500,000 (approx.) for access roads in the vicinity of Army and Navy posts.

$2,000,000 for W.P.A. construction throughout the State, and

$2,500,00 for W.P.A. access roads.

While the total amount of funds available for highway construction and maintenance is $30,000,000, it is not anticipated that this amount of work will be placed under construction during the year 1942 due to the shortage of critical materials, equipment and man-power.

Approximately $3,000,000 will be available for the construction of access roads in the vicinity of Army and Navy posts. These projects are Federal-aid projects on the Louisiana Military Strategic Network and the location has not been definitely determined.

A summary of proposed construction for the year 1942 includes 35 miles of concrete pavement, 45 miles of bituminous surface treatment, 100 miles of aggregate type surfacing, 60 miles of grading, 25 miles of roadside improvements, 20 miles of bituminous pavement, 1100 miles of reconditioning, and the construction of numerous bridges, overpasses and underpasses.

Oklahoma

Tables showing the state highway department's approximate expenditures for 1941 and probable expenditures for 1942 are given below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941

Construction	$8,101,000
Maintenance	8,900,000

Probable Expenditures in 1942

Construction	3,455,000
Maintenance	4,000,000

Equipment purchases are included in the above construction and maintenance figures.

The state highway construction program for 1942 has not yet been completed.

Texas

During 1941 the state highway department placed approximately 60 per cent of its total revenues received from all sources on the strategic military network highways, cooperating with the Federal government in improving roads for national defense. Details of work completed for the fiscal year ending August 31, 1941, are given below:

STATE HIGHWAY EXPENDITURES

Construction Expenditures	$48,404,000
Maintenance Expenditures	9,702,000
Bridge Construction	3,807,000
Grade Separation Construction	3,095,000
Equipment Purchases	1,014,000

STATUS OF STATE HIGHWAY SYSTEM AS OF DECEMBER 1, 1941

Type	Miles
Unimproved	1,486
Grading and Small Structures	1,089
Gravel, Caliche, etc., Surface	462
Asphalt Surface (all types)	14,836
Concrete and Similar Types	5,426
Bridges Completed (number)	46
Park Roads (state maintained)	104
City Mileage (not state maintained)	600
Other Designated Mileage (not state maintained)	2,356
Entire State System	25,836

The state highway program for 1942 is still uncertain because allocations from the Defense Highway Act appropriation have not yet been made. The highway department, however, is in the process of preparing plans for military access roads desired by the War Department, which will cost approximately $10,000,000. Probably the maximum the state military access roads might expect under the bill would be half or less than $10,000,000.

All federal funds available to the state highway department and not under contract must be placed on military access roads, or strategic military highway network. This means that all of the highway department's federal aid appropriations, along with matching state funds, are to be placed upon the military network. Since this was anticipated, all of the current program of regular federal aid work is located on the strategic military network.

This network is made up of state highways and Texas has almost 7500 miles of its state highways included in this National network of military routes.

Under new instructions from the national government, all secondary highway money or farm-to-market road money must be expended on the military network. Therefore, all secondary projects that heretofore have been approved by the Commission, but have not been placed under contract, will be suspended for the duration of the emergency, and

A typical "old timer." Maintenance expense is high and the increased weight and speed of modern traffic has made this bridge dangerous and obsolete.

Sturdy ARMCO Multi Plate keeps costs down and speeds construction. Sections are delivered to the job site ready for immediate assembly by unskilled men.

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ARMCO MULTI PLATE PIPE AND ARCHES

those funds originally allocated to these secondary projects will now be placed on the strategic military network.

Grade separation funds are almost entirely allocated to the strategic military network at this time, consequently no drastic change is expected in the operation of these funds during 1941.

It is necessary that state funds be spent either on the strategic military network, or on a type of road work that will not require critical defense materials. A major part of state funds already have been concentrated on the strategic military network and now more than ever before must go to speed improvements on state highways included in the network.

Estimates by the highway departments show that between $80,000,000 and $90,000,000 is needed to bring the Texas portion of the strategic military highway network up to minimum requirements.

Mountain States

Montana

Approximate expenditures, complete and uncomplete mileages for 1941, and the probable program for 1942 for the state highway department are shown in the tables below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$4,647,178
Bridge Construction	714,287
Grade Separation Construction	109,091
Maintenance	2,100,000
Equipment Purchases	160,000
Probable Expenditures in 1942	
Highway Construction	$4,960,000
Bridge Construction	800,000
Grade Separation Construction	240,000
Maintenance	2,960,000
Equipment Purchases	250,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Bituminous, Low Cost	87
Gravel, Untreated	244
Gravel, Treated	16
Graded and Drained	238
Bridges (number)	83

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

	Miles
Bituminous, Low Cost	154
Gravel, Untreated	249
Gravel, Treated	32
Graded and Drained	162
Bridges (number)	58
Grade Separations (number)	3

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Bituminous, Low Cost	130
Gravel, Untreated	70
Bridges (number)	50
Grade Separations (number)	3

Due to changes being made in Federal Aid regulations, the state highway department is unable to program 1942 funds to definite projects at this time.

Idaho

The state highway department during 1941 practically completed the following program:

STATE AND FEDERAL HIGHWAYS

	Miles
Grading and Draining	250
Surfacing	276
Concrete Pavement	10
Oiling	140
Seal Coating	160

COUNTY HIGHWAYS

	Miles
Grading and Draining	279
Surfacing	286
Oiling	123
Seal Coating	40
Bridges (number)	9
Underpasses (number)	3

The state highway department also repaired 3 major bridges and with its own forces renovated approximately 275 miles and seal coated 365 miles of the main highway system.

The work listed above involves the following funds:

Federal	$2,389,258
Federal Aid Secondary	368,447
State	3,430,161
Other	1,895,022*

* Includes Sponsors funds provided by WPA, County, County highway districts and villages.

Wyoming

If during 1942, the volume of motor travel on Wyoming highways holds up the same amount as in 1941, there will be available to the highway department approximately $2,300,000. This is slightly more than was made available to the state in the way of highway user taxes and fees during 1941. A little over a $1,000,000 will be necessary for general operating expense including administration and maintenance.

Approximately $2,500,000 worth of work which is now under contract and uncompleted will be carried over in the next construction season. No program for construction has been made for 1942, but it is anticipated that what funds are available will be used for surfacing jobs which are now under contract or have been completed as to grading and bridge work, construction of some state secondary roads, and some reconstruction in the way of placing armored coats, widening, and additional base courses on the heavier traveled roads. One or two grading jobs may also be included in the program.

Work amounting to approximately $4,500,000 has been put under contract during 1941. Therefore, the construction program for 1942 will be considerably less than half of the construction work in 1941. The 1942 figure, however, will be possibly increased depending upon the national defense authorities.

Approximate state highway expenditures for 1941 and probable expenditures for 1942 are given below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway, Bridge, and Grade Separation Construction	$4,500,000
Maintenance	800,000
Probable Expenditures in 1942	
Highway, Bridge, and Grade Separation Construction	$2,300,000
Maintenance	920,000

Colorado

One of the outstanding projects of the 1941 state highway program was the completion of 550 miles of low-cost bituminous surfacing. Tabulations of the 1941 work and the new work for 1942 are given below:

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941	
Highway Construction	$4,300,000
Bridge Construction	500,000
Grade Separation Construction	300,000
Maintenance	1,295,000
Equipment Purchases	205,000

STATE HIGHWAY EXPENDITURES

Probable Expenditures in 1942	
Highway Construction	$4,350,000
Bridge Construction	500,000
Grade Separation Construction	400,000
Maintenance	1,500,000
Equipment Purchases	250,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Bituminous, Low Cost	550
Graded and Drained	120
Bridges (number)	23
Grade Separations (number)	3

STATE HIGHWAY CONSTRUCTION UNCOMPLETE—CARRIED OVER TO 1942

Type	Miles
Bituminous, Low Cost	40
Graded and Drained	64
Bridges (number)	37
Grade Separations (number)	5

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Bituminous, Low Cost	600
Graded and Drained	125
Bridges (number)	40
Grade Separations (number)	5

New Mexico

Due to the uncertain status of future Federal Aid funds the figures given below, showing the probable expenditures and mileage for 1942, are subject to change.

STATE HIGHWAY EXPENDITURES FOR 1942

Construction	$ 9,118,058.04
Maintenance	2,398,184.56
Administration	373,403.00
Other:	
Construction Engineering	510,922.97
Location Engineering	342,692.00
Equipment and Property Purchases and Repairs and Misc. Expenditures	300,000.00
Total	$13,043,260.57

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Bituminous Macadam (Gd., Dr., Surf. & Oil Proc.)	26
Bituminous, Low Cost (Double Penetration)	60
Gravel, Untreated (Gd., Dr. & Surf.)	73
Graded and Drained	113
Bridges (number)	5
Grade Separations (number) Struct.	1
Reproc. & Sealing	161
Miscel. Roadside Improvements	30

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

Type	Miles
Bituminous Macadam (Gd., Dr., Surf. & Oil Proc.)	6
Bituminous, Low Cost (Double Penetration)	44
Gravel, Untreated (Gd., Dr. & Surf.)	23
Gravel, Treated	7
Graded and Drained	33
Bridges (number)	4
Grade Separations (number)	1
Reproc. & Sealing	39

APPROXIMATE MILEAGE OF STATE HIGHWAY SYSTEM TO BE IMPROVED DURING 1942

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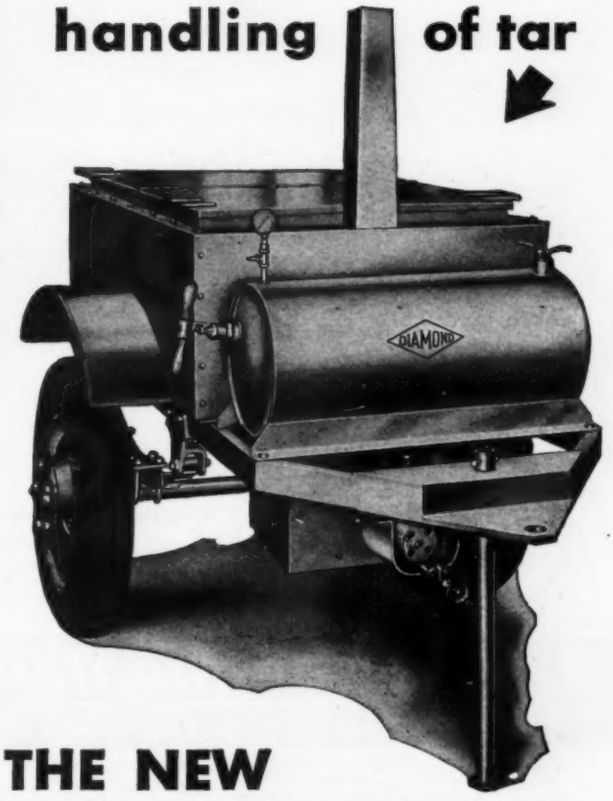

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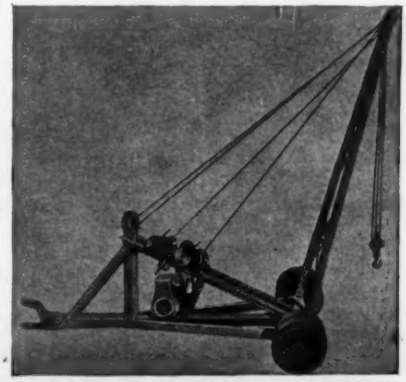
Double circulated heat is furnished by a MAHR torch unit to a large combustion chamber which affords greatest fuel economy. But a few minutes are needed to light burner and have tar or asphalt ready for use. Ruggedly built for long service, yet light enough and flexible for quick, easy moving from place to place. Has many features any highway superintendent will appreciate.



The PORTA CRANE is the answer to many a daily problem of lifting and moving on the job. Portable. Can be hauled from place to place. Will lift and move, and can even be used as a dragline. Ask for complete details and prices.

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Type	Miles
Grading, Drainage & Grav. Surf....	150
Double Penetration Bituminous Surfacing	175

FUNDS AVAILABLE IN 1942

State Gasoline Tax.....	$ 2,834,913.34
State Motor Vehicle Tax....	903,000.00
Other	42,500.00
Federal Aid (Primary).....	2,815,406.31
Federal Aid (Secondary)....	388,450.17
Federal Aid (Grade Crossing)	711,526.28
Federal Aid (Other).....	2,045,230.20
Sale of Debentures.....	2,000,000.00
Cash Balance	1,302,234.27
Total	$13,043,260.57

MAINTENANCE EXPENDITURES DURING 1942

Snow Removal	$ 60,000.00
Equipment Purchases	175,000.00*
Minor Betterments	60,000.00
Other Road Sign and Center Striping	131,200.00

* Not included in Maintenance Budget.

Arizona

This tabulation gives information on 1941 work and the probable 1942 program of the state highway department.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941

Highway, Bridge, and Grade Separation Construction	$4,480,000.00
Maintenance	1,524,000.00
Other Expenditures	1,188,000.00
Highway, Bridge, and Grade Separation Construction	$4,611,000
Maintenance	1,671,000
Other Expenditures	1,170,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Probable Expenditures in 1942

Type	Miles (Estimate)
Portland Cement Concrete....	5
Bituminous Macadam	105
Bituminous, Low Cost.....	41
Gravel, Untreated	14
Graded and Drained.....	7
Bridges (number)	45
Grade Separations (number)..	2

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete.....	15
Bituminous Macadam	120
Bituminous, Low Cost.....	50
Gravel, Untreated	20
Graded and Drained.....	10
Bridges (number)	45
Grade Separations (number).....	2

Utah

The following tables give information on the 1941 state highway department's construction program and the probable program for 1942.

STATE HIGHWAY EXPENDITURES

Approximate Expenditures in 1941

Highway Construction	$2,000,000
Bridge Construction	280,000
Grade Separation Construction.	16,000
Maintenance	1,300,000
Equipment Purchases	250,000

Probable Expenditures in 1942

Highway Construction	$4,500,000
Bridge Construction	500,000
Grade Separation Construction.	530,000
Maintenance	1,500,000
Equipment Purchases	150,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Portland Cement Concrete....	8
Asphalt	5
Bituminous, Low Cost.....	130
Gravel, Untreated	25
Graded and Drained.....	15
Bridges (number)	11

STATE HIGHWAY CONSTRUCTION UNCOMPLETE — CARRIED OVER TO 1942

Type	Miles
Gravel, Untreated	15
Graded and Drained.....	5
Grade Separations (number).....	1

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Portland Cement Concrete.....	16
Asphalt	4
Bituminous, Low Cost.....	100
Gravel, Untreated	30
Graded and Drained.....	20
Bridges (number)	14
Grade Separations (number).....	5

Nevada

In the event that Federal funds are apportioned, in accordance with the regular Federal Aid authorization for the fiscal year 1943 and the authorization under the War Defense Act just recently passed by Congress, the state highway department will propose the following program:

STATE HIGHWAY EXPENDITURES FOR 1942

Highway Construction	$2,502,000
Maintenance	900,000
Surveys and Plans, Equipment Purchase, Signing and Centerline Stripping, Administration, etc.	815,000

ESTIMATED REVENUE FROM VARIOUS SOURCES

Regular Federal Aid including Secondary and Grade Crossing Funds	$1,597,000
War Defense for Strategic Network only	320,000
Total	$1,917,000
State Sources	
Gasoline Tax	$1,625,000
Vehicle License Fees and Others	675,000
Total	$2,300,000
Total from All Sources	$4,217,000

The highway program given above will be an increase of $375,000 over 1941 expenditures. All proposed construction for 1942 will be on the Strategic Network of War Defense Highways.

The amount of highway excavation awarded in 1941 which will be carried over into 1942 will be 795,000 cubic yards (the contract price for which is $286,000). Equipment purchased in 1941 for maintenance uses cost $314,000.

The state highway department has had certified, certain Access Road Projects totaling nearly $1,000,000. These projects may be placed under construction during 1942. This depends, however, on Federal appropriations.

Pacific States

Washington

In the funds tabulated below for expenditures in 1941 and probable expenditures for 1942, the accounts are divided into two groups. Highway construction includes road work, bridges, grade separations, right of way and location. Maintenance includes equipment purchases and rentals.

STATE HIGHWAY EXPENDITURES IN 1941

(Including Federal Aid)

Highway Construction (including right of way and location)	$ 7,000,000
Maintenance (including equipment purchased and rentals)	3,800,000
Total	$10,800,000

ESTIMATED EXPENDITURES IN 1942

Highway Construction (including right of way and location)	$ 7,560,000
Maintenance (including equipment purchased and rentals)	3,820,000
Total	$11,380,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles (Estimate)
Grading and Surfacing	97
Paving (high type)	8
Bituminous Surfaces)	397
Bridges (number)	12
Grade Separations	1

PROBABLE MILEAGE OF STATE HIGHWAY CONSTRUCTION IN 1942

	Miles
Grading and Surfacing	390
Paving (high type)	12
Bituminous Surfaces	491
Bridges (number)	40

Oregon

During 1941 the approximate expenditures by the state highway department totaled $12,755,000. Details are given in the tables below:

STATE HIGHWAY EXPENDITURES FOR 1941

Highway Construction	$7,000,000
Bridge Construction	600,000
Grade Separation Construction	400,000
Maintenance	4,230,000
Equipment Purchases	525,000

MILEAGE OF STATE HIGHWAY CONSTRUCTION COMPLETED DURING 1941

Type	Miles
Portland Cement Concrete	8
Bituminous Concrete	24
Bituminous Macadam	60
Macadam, Low Cost	220
Stone and Gravel, Untreated	312
Graded and Drained	266
Bridges (number)	27
Grade Separations (number)	3

No definite information regarding the 1942 state highway program is available at this time.

California

The division of highways, as all state departments in California, operates upon fiscal year periods covering two years and state highway budgets are prepared upon a biennial basis. At the present time the highway budget is for the biennial period from July 1, 1941 to June 30, 1943.

After the start of the biennium it became apparent that a revision of the budget was necessary as rapidly rising construction costs invalidated many of the preliminary estimates upon which the budget was based.

The new budget provides allocations for construction and improvement to the total sum of $60,320,000, including all work put under way since the beginning of the biennium. This amount of $60,320,000 sets up $40,938,000 for construction projects and contingencies, $9,438,000 for improvement to state routes in cities, and $9,945,000 for right of way, engineering, and joint highway districts.

During 1941, the California division of highways expended or placed under construction and maintenance, work in the

total sum of $35,859,000. This total includes the sum of $23,631,000 for construction and $12,228,000 for maintenance operations.

Segregation of these amounts to the various phases of state highway work is shown in the following tabulation:

CONSTRUCTION	
Construction and Maintenance Contracts	$11,845,900
Day Labor Construction	4,978,900
Day Labor Minor Improvements	210,900
Day Labor Betterments	288,200
Contributions to WPA work in Los Angeles	335,000
Convict Construction	655,000
Engineering for Defense Projects Off the State System	413,000
Engineering	3,315,800
Right of Way	1,588,300
Total Construction	$23,631,000

MAINTENANCE (DAY LABOR)	
General Maintenance	$ 5,123,500
Replacements	3,473,800
Slide Removal	2,942,900
Buildings and Plants	157,400
San Francisco - Oakland Bay Bridge	530,000
	$12,227,600
	$35,858,600

The $11,845,900 allotted to construction and maintenance contracts provided the following types of improvement during 1941:

Grade and dual type	7.6	$ 404,400
Grade and Portland cement concrete	17.3	1,359,700
Grade and asphalt concrete	13.6	988,900
Grade and plant mixed surface on cement treated base	16.9	690,400
Grade and plant mixed surface	110.0	1,585,000
Grade and road - mix surface	36.0	375,600
Grade and bituminous surface treatment	16.1	904,400
Grade and oiled gravel surface	7.8	372,600
Oiled earth	10.1	153,500
Armor Coat and retread surfacing	15.0	85,900
Seal Coat	101.6	151,000
Grading only	10.3	470,400
Weed oiling	668.0	17,000
Bridges and grade separations (number)	55	3,876,200
Miscellaneous contracts.		410,900
Total		$11,845,900

The following tabulation gives the source of funds from which this $11,845,900 in contracts was financed.

Source	Amount
State Highway Funds	$ 6,476,300
Regular Federal Aid Funds	3,843,100
Federal Aid Secondary Funds	516,000
Federal Aid Grade Crossing Funds	661,100
Bureau of Reclamation Funds.	293,600
County Funds to Match Federal Feeder Funds	55,800
	$11,845,900

During the past year the California division of highways and the Public Roads Administration have been working in close contact with military authorities, and the needs of highway improvement have been definitely determined for both access road construction and further development of the strategic highway network.

An access road program amounting to over $40,000,000 has been established and by use of Federal Aid and Federal Aid Secondary or Feeder funds to defray engineering charges, surveys have been made and plans prepared on access projects to a value of approximately $15,000,000. As soon as apportionments are made from the $150,000,000 authorized for access road construction under the Defense Highway Act, the state highway department will place under way as much of the access road program as apportioned funds will permit.

Trunk Highway Streets Favored

The State of Minnesota spends more money for construction on trunk highways within municipalities than the municipalities spend for construction on all their streets and alleys, according to data gathered by the Highway Planning Survey.

In municipalities of more than 1,000 population the state spent $2,398,230 for construction of trunk highways in a typical year. Total expenditures by those municipalities for construction, including rights-of-way, on all their streets and alleys in the same year, were $1,714,801.

For maintenance the same year, municipalities of more than 1,000 population spent $2,483,362 on all streets and alleys, while the state spent $397,336 to maintain the trunk highways within these municipalities. Both figures include snow removal. While the state outlays for maintenance totaled much less than outlays by the municipalities, they were 75 per cent greater on a per mile basis.

Reviews of Books and Booklets

Investigation of Soil Conditions in Airport Construction

***Reviewed by* V. J. BROWN**
Publishing Director

DEVELOPMENT of an airport site requires first of all an investigation of soil conditions, including such factors as soil characteristics, soil profile, ground water level, drainability, subgrade support for runways under all weather conditions, and suitability of the soil for stabilization. A bulletin just published by the Department of Civil Engineering, University of Michigan, entitled "Investigation of Soil Conditions in Airport Construction" and written by Prof. W. S. Housel, who is also research consultant for the Michigan State Highway Department, is devoted principally, to a discussion of two of the above points; (1) a discourse on why the soil classifications of the Soil Survey Division of the U. S. Bureau of Chemistry and Soils should be utilized to much greater extent, and (2) remarks regarding soil tests which should be made and an analysis of subgrade support based upon the data obtained from his suggested tests.

It must be admitted that Prof. Housel presents some good arguments for employment of the system of soil classification developed by the U. S. Bureau of Chemistry and Soils. In the highway field, the classification proposed by the U. S. Public Roads Administration, the A1-A8 groupings, have been widely adopted. There are, however, a few states which use the former. While the writer has employed the A1 to A8 system of classification in some of his writings, he is inclined to prefer neither one of the classifications discussed herein. The writer feels that the formula developed by Mr. Keith Boyd, Materials Engineer for the North Dakota State Highway Department, holds the best promise for practical utility in the highway field. "This type of information is particularly applicable to the problems that arise preliminary to the actual design and construction of improvements and have their value in guiding the all-important decisions as to where the airport shall be built and what general improvements may be necessary." Identification of a soil type as a poorly drained clay indicates the probability that some type of paved runway will be required for year 'round operation. For designing the paved runway, it is necessary (for the sake of economy and for a surety against surface failure) to measure the ability of the subgrade to support loads, and the ability of the proposed runway material to distribute these loads. The measurements are necessary in order to provide information upon which to design a definite thickness of surfacing.

The bulletin, under the heading "Soil Classification and Soil Terminology" discusses how work already done by the U. S. Bureau of Chemistry and Soils can be economically employed by engineers. He includes a triaxial chart of soil textures showing how it aids in soil type identification. The author claims that there seems to be no way short of actual experience with soil survey maps which will provide the emphasis the subject needs.

Under the heading "Soil Tests" Prof. Housel discusses a rational

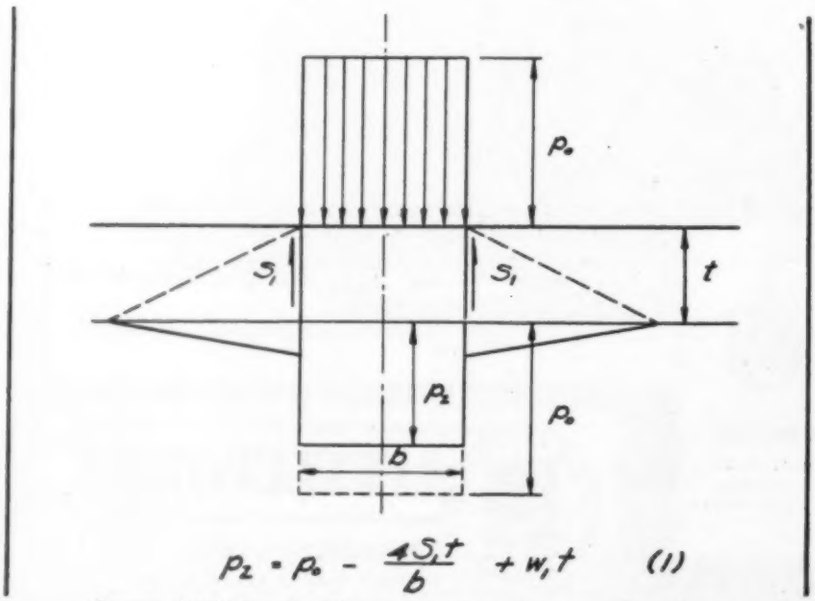
method of bearing capacity analysis, freely admitting that other procedures are available although the method of loading a bearing plate may be unsuitable for sub-base analysis. By his method he develops the bearing capacity to be four times the cohesive shearing resistance of the soil sub-base. With granular soils his analysis of load carrying capacity of a confined granular mass may be expressed by the formula,

$$p_v = p_h \cot^2 \theta$$

From which he states, "Thus the pressure sustained by a loaded element is a function of the horizontal thrust and the angle at which the pressure is transmitted and independent of the shearing resistance acting on the diagonal plane" established by the angle θ.

Continuing with his analysis the accompanying illustration explains his conception of the action of shearing resistance in transmitting pressures through a pavement surface or stabilized base. Ability to distribute the applied load laterally and to decrease the pressure transmitted to the subgrade is accomplished through shearing resistance. Inasmuch as the runway surface or base will in all probability be a stabilized granular mixture of some sort, the effect of normal pressures and mechanical interlocking must be measured by a shear test which measures the punching shear involved. By equating the pressure transmitted to the supporting pressure of the subgrade, it is possible to obtain a rational formula for the required thickness of the surface in terms of measurable properties.

Prof. Housel agrees that loading tests in the field may be employed but believes that stability tests in the laboratory are more feasible. In discussing other soil properties under the head of "Drainability" he has this to



Pressure distribution through a paved runway due to punching shear

say, "The measurement of capillarity and permeability of soils is a difficult procedure and suggested test procedures are not generally accepted." This is a forthright, clear statement.

In fact, the entire bulletin is forthright, clear, plain and logically arranged.

Soil Mechanics and Foundations

Fred L. Plummer, Consulting Engineer, Cleveland, Ohio, and Stanley M. Dore, Assistant Chief Engineer, Massachusetts Metropolitan District Water Supply Commission, have collaborated on a new book just published by the Pitman Publishing Corporation, 2 West 45th St., New York, N. Y. It is a 473-page book priced at $4.50 per copy.

During recent years significant advances have been made in our understanding of the performance of soils used for engineering purposes. This book represents the efforts of the authors to correlate, summarize, and simplify these developments for the benefit of those who have not had an opportunity to specialize in this field, and for those who are just beginning to study such problems. This may sound like what has been presented is simple and elementary. Disillusion yourself of this idea right now. The study of soil mechanics is involved and in some cases wrapped up in abstruse mathematical theorizing. The authors profess that this book is not intended for research workers specializing in the field of soil mechanics, but rather for engineers and students who wish to become familiar with the basic principles, the terminology, the types of tests, and the methods of application to engineering problems. The writer comments to the effect that much of the book is taken up with applications of basic principles to engineering problems and that study of the text requires close attention.

The classification of the constituency of soils established by the U. S. Bureau of Public Roads as well as that of the U. S. Bureau of Chemistry and Soils is explained in this text. The authors truly state that "There is lack of uniformity throughout the country in the division between soils of various classes; for example, the size which divides fine sand from medium sand or medium from coarse, etc." They could also have pointed out that there is lack of uniformity in general classification for distinguishing types of soils.

The authors very thoughtfully used many illustrations, tables, and formulas to explain the text. Their book shows a wide scope of reading on the subject as well as an intimate knowledge of the application of some of the principles on work over which they (or one of them) had supervisory control. The treatment is a pleasing blend of the academic and the practical.

The chapter on Soil Compaction has not been fully developed. The discussion revolves mostly around the report of Proctors' investigation. Much more newer data have been developed regarding relationships of equipment to compaction and regarding test procedures employed. Likewise, the chapter on Foundations for Highways was insufficiently treated. Enough was given, however, to arouse the interest of anyone desiring to make more complete investigations.

The book is a useful addition to the engineer's library and represents years of effort by the authors.

Speed Regulation

A report under the above title has been released by National Safety Council, 20 North Wacker Drive, Chicago, Illinois. Sections of this report which should be of most interest to our readers are those dealing with Speed Zoning and establishment of speed zones, and the part dealing with methods for making speed observations. Other sections deal with speed legislation, enforcement, education, and speed as a factor in traffic accidents.

Proceedings of Engineering Conference in Soils for Engineers

At Michigan State College in March, 1940, a soils conference was sponsored by Prof. C. R. Allen, Division of Civil Engineering, G. D. Kennedy, State Highway Commissioner, and R. W. Tenny, Director of the Short Course Department of Michigan State College. This book is a planographed report of the proceedings and papers presented. The purpose of the conference was to study the highway phase of soils engineering.

The first paper is entitled "The Glacial History and Development of Michigan," by S. G. Berquist, Professor of Geology, Michigan State College. It explains modern theories on how the soil and contour of Michigan was formed from the several glaciers that charged over the area.

The second paper is entitled "Soil Classification," by J. O. Veatch, Professor and Research Professor of Soils, Michigan State College. This paper discusses the characteristics of the various strata of surface soils. Drainage characteristics and geologic derivation are touched upon.

The third is entitled "Soil Surveys for Highway Purposes," by A. E. Mathews, Assistant Engineer of Soils, Michigan State Highway Department. It is a detailed discussion of Michigan's method of making soil surveys and includes a description of the soils administrative setup. The Michigan State Highway Department uses the soil classification procedure of the U. S. Division of Soils of the Bureau of Plant Industry in preparing their soil survey of a proposed route.

The fourth paper is entitled "Natural Conditions Affecting Performance of Soils," by J. W. Kushing, Research Engineer, Michigan State Highway Department. From the standpoint of the engineer, it is essential that each soil be considered as an individual entity, the behavior of which is the reflection of its own properties and environment.

The fifth paper is entitled "Soil Characteristics, Their Determination and Significance," by F. R. Olmstead, Engineer of Field Testing, Michigan State Highway Department. It discusses the standardized testing procedures and soil classifications.

The sixth paper is entitled "Practical Utilization of Subgrade Soil—Information in Highway Design Practice," by O. L. Stokstad, Engineer of Soils, Michigan State Highway Department. The best way for a soils engineer to become indispensable is for him to present soil engineering data in such form as to assist design engineers in making their own applications. This paper discusses the various duties of soils engineers as they relate to and coordinate with design. engineers.

The seventh paper is entitled "Soils and the Engineer," by R. F. Legget, Ass't. Professor of Civil Engineering, University of Toronto. This paper is an historical recitation of quotations from the engineers of antiquity.

The eighth paper is entitled "Soil Mechanics in Engineering," by W. S. Housel, Associate Professor Civil Engineering, University of Michigan. This paper is a discussion of those specific measures of soil properties that must be made before the thickness of the pavement or the size and spacing of the subdrains can be calculated. It is an outstanding contribution to soil mechanics.

The ninth paper is entitled "Soil Stabilization," by Wm. Aldous, Senior Engineer, Civil Aeronautics Authority, Ann Arbor, Mich. This is a running discussion on a moving picture film.

New Equipment and Materials

New Force-Feed Loader

A new force-feed loader for use behind a motor grader, truck or tractor has been announced by Athey Truss Wheel Co., 5631 West 65th St., Chicago, Ill. This loader is available also in a self-propelled unit. The machine scoops up windrows of earth, dirt, rocks, or other materials from

Athey Force-Feed Loader

the road surface behind the blade of the motor grader and conveys the material over a belt into a truck which is loaded as it moves. Power is furnished by a 22 hp. gasoline engine mounted on the chassis. An operator's platform is provided which is convenient to all control levers. The purpose of the Athey force-feed loader is to clean up excess materials from road or street surfaces following maintenance or grading work.

New Truck Mixers

The T. L. Smith Co., Milwaukee, Wis., has announced a new No. 3½ Smith-Mobile with ratings of 3½ cu. yd. for truck mixing, 4.27 cu. yd. for shrink mixing, and 4.58 cu. yd. for

New Smith-Mobile Truck Mixer

agitating. This new machine replaces the former No. 3 Smith-Mobile. With its larger 165 cu. ft. drum volume and sturdy, lightweight construction, this new model is said to permit much bigger pay loads. New, compact, streamlined design, and liberal use of Manten steel in important parts, has effected weight economies. It is claimed this new Smith-Mobile is much faster in charging, mixing and discharging, especially for the drier and stiffer mixes. Features of this new model include: New, all-geared, fully enclosed transmission—Totally enclosed, oil-tight pump drive—Big 36 in. drum opening with self-centering feed chute — New, sealtite, self-cleaning closing door with worm and worm gear operating unit—Big, 160-gal. capacity water tank, with larger overflow pipes—Powerful 42.5 h.p. engine.

New Double Angle Moil Point

The Iron City Spring Co., 2917 Smallman St., Pittsburgh, Pa., has developed a double angle moil point. The shank is hexagon, the taper is square, and the cutting point is round. The Iron City moil points are heat treated by a process especially developed to bring out the fine qualities of the steel and to give the point long resistance to wear. The new double-angle moil point is furnished in lengths of 14 in. to 30 in., and with shanks 1⅛ in. and 1¼ in. x 6 in.

New Twin Unit Crushing Plant

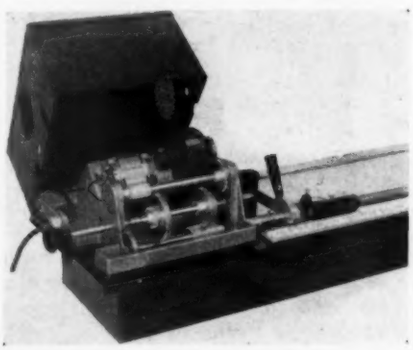
The Austin-Western Road Machinery Co., Aurora, Ill., has recently placed on the market a highly portable double unit crushing plant stated to be capable of delivering exception-

New Austin-Western Twin Unit Crushing Plant

ally large outputs of crushed gravel or stone. The reduction unit is suited equally well for gravel or for quarry service and consists of a 4022 all roller bearing roll crusher, 4 ft. x 12 ft. triple deck gyrating screen and rotary return elevator all mounted on a six-wheel, pneumatic tired truck equipped with 30 in. feed and delivery conveyors. The primary unit which is used ahead of the secondary unit for gravel service normally consists of a 1036 jaw crusher with scalping screen mounted on a truck with a feed conveyor; for quarry service a large opening jaw crusher with apron type feeder is used. By carefully designing all composite parts and members, the moving weight of the secondary plant has been held to 39,000 lb. with an overall width of 8 ft. and overall height when operating of 13 ft. Height can be very readily reduced to 12 ft. to provide additional transporting clearance. Similarly, the weight of the primary unit for gravel service is but 23,000 lb. with an overall width of 8 ft. and height of 11 ft. The use of two units provides a most flexible arrangement, capable of meeting the various material specifications from local deposits; it also permits all parts to be readily accessible.

New Machine for Testing Ductility of Bituminous Materials

Presenting several new and exclusive features, the new ductility machine announced by the Precision Scientific Company, 1750 North Springfield Ave., Chicago, Ill., complies with Designation D-113 of the American Society for Testing Materials, for testing the ductility of bituminous materials at speeds of ¼, 1 or 5 cm. per minute. Having a

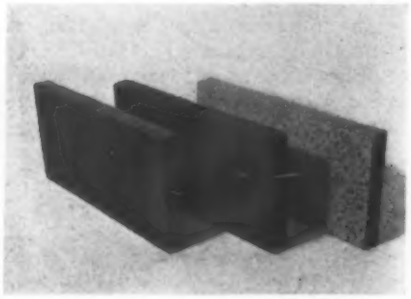


New Ductility Testing Machine

depth of 5 in., ample room is allowed for insertion of cooling coils or ice when conducting tests at reduced temperatures. The selective gear-drive mechanism, fully enclosed in a metal housing, is of the automotive type, with all gears of bronze, on steel shafts. Bearings are oil-less type, requiring no lubrication. Speed selection is virtually instantaneous, by means of a gear shift lever protruding from the gear-drive housing. Readings can be taken up to 150 cm. The scale is divided in centimeters and millimeters, and the indicating pointer adjustable, so that it can be set to the exact zero position at the starting point. The machine can be suspended in a table top for flush mounting, often desirable; or can be suspended in a tank for circulating liquid to maintain constant temperature.

New Expansion Joints

A line of asphalt, fibre and cork expansion joints designed to meet all requirements of monolithic concrete construction, including pavements, sidewalks, industrial floors and similar applications, has been announced by Keystone Asphalt Products Co., 43 E. Ohio St., Chicago. Each type is supplied to meet federal and state specifications and can be fabricated to meet specifications of any special job. The asphalt joint is composed of asphalt, fibre and mineral fillers, formed into sheets and reinforced with a layer of felt on both sides. It is stated to possess a high degree of compressibility to permit perfect coordination of expansion with slab movement. The fibre joint consists of a fibre board impregnated with a



Left to right: Asphalt, fibre and cork expansion joints

waterproof asphalt to provide a non-extruding, resilient product that permits free action of the concrete slab. It is thoroughly seasoned after impregnation so as to retain its form without danger of breakage on the job, and to provide true alignment when being installed. The cork joint, made from new live cork particles with a resinous binder, is produced under heat and pressure to retain all inherent features of the natural cork. It has a very limited extrusion factor, and is rated to recover in excess of 95 percent on resiliency test.

All joints are regularly supplied in a wide range of sizes and thicknesses, and can be readily supplied in special sizes for special applications. They are free of any foreign substance that might cause trouble in special cutting applications, or reduce their efficiency when installed.

New Athey Model 8 Mobiloader

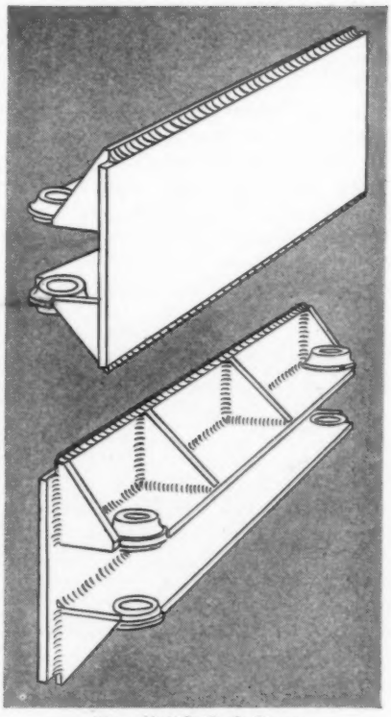
A new Model 8 Mobiloader which is powered by the "Caterpillar" D8 tractor has been announced by the Athey Truss Wheel Co. of Chicago, Ill. Companion model is the W4 Mobiloader which is being used on a wide variety of loading operations. Exhaustive tests for more than two years on actual operations in mines, quarries, on highway and earthmoving jobs, the manufacturer states, have proved the many advantages in speed and loading efficiency that the

New Athey Model 8 Mobiloader

Model 8 Mobiloader offers. The Model 8 Mobiloader, which is sold by "Caterpillar" dealers, digs at the front and dumps overhead to the rear, employing the same principle as the W4 Mobiloader. With bucket capacities ranging from 2.7 to 9½ cu. yd., depending upon the type of materials to be handled, the Model 2 Mobiloader loads earth, ore, sand, clay, coal, gravel, stone and many other materials. For full information and literature write Athey Truss Wheel Co., 5631 W. 65th St., Chicago, Illinois.

New Unitilt Push Dozers

The development of a new line of unitilt push dozers and push dozer pads for use on Buckeye unitilt bulldozer frames has been announced by



New Unitilt Push Dozer

the Buckeye Traction Ditcher Co., Findlay, O.

These units are now being built in two sizes: 24 in. x 61 in. for Allis-Chalmers HD-14 and HD-10-W tractors, International WTD-18 and WTD-14 tractors, and Cletrac FD Series machines; 24 in. x 57 in. for Allis-Chalmers HD-10 and International TD-18 tractors.

The Buckeye unitilt push dozer pads are interchangeable on the same frame with Buckeye unitilt bulldozer and trailbuilder blades.

WITH THE MANUFACTURERS

Harold G. Saunders Appointed Manager at Philadelphia for Kinney

Harold G. Saunders, who has had 22 years' experience as district manager at Kansas City, Mo., and Dallas, Tex., for Kinney Manufacturing Co., Boston, Mass., has been appointed manager of the Philadelphia office, succeeding C. D. Campbell, Jr., resigned. Henry A. Perry, Jr., of the Boston office, has taken Mr. Saunders' place as manager of the Dallas office.

Kotal Co. Acquires Asphalt Treatment Corp.

The recently organized Kotal Co., headed by Howard B. Bishop of Summit, N. J., has acquired the business heretofore conducted by the Asphalt Treatment Corporation at 140 Cedar St., New York City. The company, which moved into new offices at 52 Vanderbilt Ave., New York, on January 1st, manufactures a waterproofing agent for use on aggregates employed in asphalt highway construction and maintenance. Mr. Bishop has devoted the greater part of his life to the development of chemical processes used in industry, and was at one time president of the John C. Wiarda Co. of Brooklyn, N. Y., which supplied the hydrofluoric acid used in the manu-

Howard Bishop

facture of the first aluminum made in the United States. In 1929 the chemical jobbing branch of this firm was sold to a company acquired by the American Cyanamid Co.; while the manufacturing division became a part of the Sterling Products Co. which Mr. Bishop organized in 1908. This latter concern was recently sold to Pennsylvania Salt Manufacturing Company. Associated with Mr. Bishop in the management of the Kotal Co. are Herbert P. Pearson, in charge of production and research, the same positions he held in the Asphalt Treatment Corporation, and Charles H. Welling as general manager of the company.

Inectrol Co. Moves to New Plant

The Inectrol Co. has moved to greatly enlarged quarters at 470 Frelinghuysen Ave., Newark, N. J., where the laboratory and factory will be combined with the general offices. The New York office has been closed and all business is being transacted from the new address at Newark, N. J.

Lt. Skidmore of Marmon-Herrington Ordered to Active Service

The U. S. Marine Corps has just ordered to active service Lt. Robert L. Skidmore, Marine Corps (retired) who has for the past three years served the Marmon - Herrington Co., Inc., as export manager. Being an accomplished linguist, he has been particularly effective in managing the rapidly expanding export business of the Marmon-Herrington Co., particularly in the Latin American countries. In addition to the actual office management of overseas business of the above company, Mr. Skidmore has made annual visits by air to all of the Central and South American countries for the purpose of establishing new distributors and maintaining contact with existing connections.

R. L. Skidmore

Sauerman Bros. Move General Offices

Sauerman Bros., Inc., Chicago, announce the removal of their general offices from 438 South Clinton St., to 522 South Clinton St., the change having taken place on December 15. The new quarters occupy an entire floor and are arranged to provide enlarged facilities for the engineering and order departments as well as an all-around improved layout for other departments of the business.

Ralph R. Hayes Made Eastern District Sales Manager for Buda

The Buda Co., Harvey, Ill., has announced the appointment of Ralph R. Hayes as its Eastern district sales manager. He will be attached to our New York office with headquarters at 253 West 64th St., New York City. Mr. Hayes is well known to trade on the eastern seaboard, especially to the marine and fishing industries. His experience includes two years as Eastern engine representative for the Caterpillar Tractor Co.; five years in the U. S. Dept. of Justice customs Agency Service; and six years as line construction Officer of boats for the U. S. Coast Guard, Washington, D. C. He has served six years with the U. S. Navy and he holds a Master Pilot's license in both the United States and Canada. Mr. Hayes replaces Lew Crafts, who recently resigned from the organization.

Dow & Co. Appointed Distributors for Rex Construction Equipment

The Chain Belt Co., Milwaukee, Wis., has announced the appointment of Dow & Company, Inc., 1820 Elmwood Ave., Buffalo, N. Y., as distributor of Rex construction equipment in the Buffalo and Rochester area. Active in this company are Burton C. Dow, President, who has associated with him John D. Eddy, located in Buffalo; W. A. Williams and J. S. Ayres located in Rochester; William E. Hanson located at Batavia; and Lee A. Beers located in Newfane. Dow & Company maintains a warehouse at the above address, with a stock of new model Rex mixers and Rex pumps and can consequently give prompt service on equipment and service requirements.

Eighmy Equipment Co. Appointed Link-Belt Speeder Shovel Distributor

Link-Belt Speeder Corporation has announced the appointment of Eighmy Equipment Co., 208 Blackhawk Building, Rockford, Ill., as authorized distributor for the complete line of Link-Belt Speeder shovels-draglines-cranes, ranging from mobile ⅜-yd. units to heavy duty 3-yd. machines. The territory covered by Eighmy Equipment Co. includes the greater part of northern Illinois, southern Wisconsin and part of western Wisconsin. Mr. B. O. Eighmy, president of the company, is well known throughout the construction field in the Mid-west territory. He was associated with the Speeder organization for 16 years, the last several years in the capacity of sales manager of Link-Belt Speeder Corporation. In March, 1940, he resigned to join A. H. Puffer & Co., Inc., construction equipment firm in Rockford. Mr. Eighmy has now formed his own company, which in addition to handling the complete Link-Belt Speeder Line, handles the products of Universal Crusher Co., Williams buckets, Gardner-Denver, F.W.D. trucks, Tru-Lay cable, and other allied accounts.

Cataphote Appointed Distributor for Scotchlite Reflecting Material

The appointment of Western Cataphote Corporation, Toledo, Ohio, as distributor for Scotchlite reflecting material for highway markers has been announced by William Searight, Cataphote general sales manager. This new product is a flexible, fabricated reflecting material, available in three colors, yellow, white and silver. Reflection is achieved through a precision surface coating of special glass polaroid lenses. Reflector buttons manufactured by the old-established Western Cataphote Corporation are widely used throughout the United States for all types of highway markers and signs. The addition of Scotchlite to their products enlarges their scope of service in the field of safety engineering.

Novo Engine Co. Has a New General Manager

The Novo Engine Co., Lansing, Mich., announces R. M. Teel, formerly general superintendent, as its new general manager and vice-president. Mr. Teel has been with the Novo Engine Co. for 7 years and had 15 years experience previously with the Reo Motor Car Co. Mr. Teel brings to the contractors equipment and industrial power field a wide range of manufacturing and managerial experience from the automotive industry. A large number of manufacturing and production improvements have been made since Mr. Teal has been connected with the company. For this critical era of Defense activity and for the adjustment period following the War, Mr. Teal has set up a two point program of constant improvement in design of the equipment and more efficient production methods.

C. M. Daniel Joins Sales Department of La Plant-Choate

C. M. Daniel has joined the sales department of the LaPlant-Choate Manufacturing Co., Inc. He will assist in the sales work at the office in Cedar Rapids. Mr. Daniel has been sales promotion manager for the International Harvester Co. at their Terre Haute, Ind., branch, and for the past several years prior to that was connected with the Davenport, Iowa branches in the Motor Truck, Industrial and Farm Equipment Divisions. He attended Iowa State College at Ames for two years, and graduated from Coe College at Cedar Rapids, having majored in Engineering and Social Sciences. He will make his home in Cedar Rapids.

J. E. O'Rourke Re-enters Manufacturing Field

The Contractors' Division staff of Chicago Pneumatic Tool Co. was augmented Dec. 1 by Mr. J. E. O'Rourke, one of the best-known sales engineers among large nationally recognized contractors. Mr. O'Rourke, who will contact leading contractors, is lo-

cated in the company's head office at 6 East 44th St., New York, N. Y. Mr. O'Rourke brings to Chicago Pneumatic over 40 years of experience, intimate associations, personal contacts in the general contracting business. A native of Rutland, Vermont, he spent his first business years learning the quarry trade with the Vermont Marble Company, and later the maintenance of machinery and tools with different contractors. From 1906 to '14 he was field engineer, salesman and branch manager of Sullivan Machinery Company. For a number of years, Mr. O'Rourke held managerial posts with large contractors handling numerous major projects including United Verde Mine Haulage Tunnel, San Pablo Tunnel for Oakland, California, Western Power Company's hydro-electric project at Lake Almanor, California, and Terrora Development of Georgia Power Company. In 1926 Mr. O'Rourke returned to Sullivan Machinery Company as Manager of Contractors' Division at Chicago. He resigned in 1938 to become Job Manager of the Delaware Aqueduct Contract of the N.Y.C. Board of Water Supply for Seaboard Construction Company—the position he occupied until recently.

Chicago Pneumatic Promotes E. Goss to El Paso Branch

The promotion of E. R. Goss to branch manager of its El Paso, Texas branch office has been announced by H. A. Jackson, President of Chicago Pneumatic Tool Co. Mr. Goss succeeds E. J. Coughlin, former manager of the branch, who was unfortunately killed in an automobile accident on Oct. 14th. Mr. Goss won his spurs as a salesman, starting with the Chicago Pneumatic Tool Co. in 1929 at its El Paso office. He was transferred to the Los Angeles branch office in 1933, and returned to the El Paso branch again in 1937, being located at Phoenix, Ariz., until the present time. time.

New Plant for Allen Billmyre Corp.

The Allen Billmyre Corporation, engineers and manufacturers of pneumatic equipment including centrifugal turbo blowers and exhausters, pneumatic conveying systems, etc., has moved into its new plant at 431 Fayette Avenue, Mamaroneck, New York. The new plant and new facilities permit employment of a larger personnel and day and night operation.

Markley in New Plant

Markley Dust Control Systems, Inc., manufacturer of rock drill dust control systems, is now in its new plant at 431 Fayette Avenue, Mamaroneck, New York. The new plant and new facilities make possible the employment of a larger personnel and day and night operation.

Gilbert H. Tompkins Dies

Gilbert Hambledon Tompkins, Secretary of Sauerman Bros,, Inc., Chicago, Illinois, died suddenly at his home Dec. 2, 1941. He was born at Butler, New York, Sept. 29, 1884. Shortly after his graduation from Ripon College he joined the Sauerman organization in October, 1909, and was with them continuously from that date. When the business was incorporated on January 1, 1925, he became secretary of the corporation and remained in that position until his death. In his 32 years with this company he traveled extensively throughout the country, and was well and favorably known in the material producing and construction industries. He is survived by his widow, two sons and a daughter.

New Trade Literature

Finegrader.—The Buckeye Traction Ditcher Co., Findlay, Ohio, has issued a new illustrated bulletin describing Buckeye R-B power finegraders for road and airport runway construction. New design features are discussed including the new tandem form wheels, hydraulic lifts, heavier frames, etc. Specifications are given on Model RB24F adjustable from 20 to 25 ft. widths and Model RB13F adjustable from 10 to 13 ft. widths. Copies of the new Bulletin are available upon request to the manufacturer.

Snow Plows.—A new booklet on snow removal, 8 pages in two colors, has just been released by the LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Ia. The booklet describes in detail the various models of snow plows manufactured for use with "Caterpillar" diesel tractors, and is filled with illustrations showing the equipment at work in the field.

Pavers.—Catalog K172 describing the Koehring 34E Twin Batch Paver has been released. Many mechanical advantages are fully illustrated and described. Of special interest to the contractor is the illustration on page 7 presenting the flow of the batch from the skip to the bucket. Many other illustrations help the contractor visualize all the important advantages of this machine. This catalog is now available for distribution, free to any person interested, by addressing the Koehring Co., Milwaukee, Wis.

Wire Rope Catalog - Handbook.—The new wire rope Catalog-Handbook of 170 pages just issued by Macwhyte Wire Rope Company boasts of many new additions helpful to wire rope consumers and lists more than 1000 ropes.

It is called "MacWhyte Wire Rope Catalog G-14" and may be had by addressing request on company letterhead to Macwhyte Company, Kenosha, Wisconsin, or its distributors.

Power Drag Scrapers.—A 24-page catalog just issued by Sauerman Bros., Inc., 488 S. Clinton St., Chicago, presents complete information on the design, construction, methods of operation and principal uses of the two most popular series of Sauerman power drag scraper machines comprising units from 1/3 cu. yd. to 4 cu. yd. in size particularly designed for all classes of light and heavy excavating duty. The data on specifications and mechanical details include a number of changes in design. The illustrations of machines in action show exactly how these machines are applied on different jobs, such as digging gravel from a hill, making a deep excavation, open pit mining, grading, dredging material from river, etc., etc.

Asphalt Literature.—An Index to the 12 issues of its Quarterly Digest of Current Asphalt Literature, Jan. 1, 1939, to Oct. 1, 1941, inclusive, has been published under date of December 1, 1941, by The Asphalt Institute. This Index serves as a quick reference to all the articles relating to asphalt that have appeared in leading Technical Magazines during the past three years. Copies are available, without charge, upon request either to this magazine or to The Asphalt Institute, 801 Second Ave., New York, N. Y.

Stop Nuts.—An interesting and instructive catalog is now being distributed by Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, N. J. The book illustrates the construction, application and mechanical features of the product with a combination of photographs and cartoons that is interesting and effective. Special designs are shown as well as complete specifications and list prices of all sizes.

Single Drum Paver.—Improvements in the Ransome 34-E Single Drum Paver are fully illustrated and described in an eight page, two color bulletin just released by the Ransome Concrete Machinery Company, Dunellen, New Jersey. Fully hydraulically controlled boom swing, discharge chute and water valve remain the outstanding features according to the manufacturer. This bulletin, No. 179, will be mailed upon written request to the company.

CLEARING HOUSE

NEW AND USED EQUIPMENT FOR IMMEDIATE SHIPMENT

Subject to Prior Sale

NEW —32" Cage Mill, 3 to 4" feed, rock or gravel, good for maximum 50% crushing, 40 to 60 tons per hour.

NEW —Steel Truck and Wheels, equipped with new pneumatic tires, tongue for tractor hitch, 10-ton capacity, for mounting 40 x 20" rolls or 15" x 30" Crusher.

USED—9" x 16" RELIANCE Jaw Crusher, good condition.

USED—Model 101 Type K DAY Limestone Pulverizer, 3 to 5 tons capacity.

USED—GRUENDLER No. 2 Monster Limestone Pulverizer, 4 to 5 tons per hour.

USED—No. 7 MITTS & Merril Wood Hog, plain bearing, 14" x 14" hopper opening, capacity 5 tons per hour.

USED—24" x 18" LIPPMAN Portable Limestone Pulverizer, with 14' elevator, in excellent condition.

USED—XXB GRUENDLER 24" x 18" welded steel Limestone Pulverizer, 6 to 7 tons per hour capacity.

USED—SCHUTTE Type F, Model L, Hammermill with or without fan for sawdust, oyster shells, etc., in excellent condition.

USED—GRUENDLER light type, 3' x 8' single deck Vibrating Screen.

USED—GRUENDLER 30" x 12" sawdust, oyster shell or fertilizer Grinder, slow speed.

USED—50-16 SUPREME (GRUENDLER) Hammermill for sawdust, oyster shells, bones or fertilizer.

ONE (1) Factory reconditioned LeRoi RA2P 65-HP gasoline power unit.

STATE FULLY YOUR REQUIREMENTS.

GRUENDLER CRUSHER & PULVERIZER COMPANY
2915-17 North Market Street
St. Louis, Missouri

EQUIPMENT FOR SALE

TRACTORS

Cletrac "DDH" Hillside Model Tractor No. 1-L-3023 with Hercules Diesel 61 H.P. motor, 18" tracks, overhauled and in very good condition.
Cat. "60" Tractor in operating condition.

EARTH HANDLING EQUIPMENT

Austin-Western 5 yard cable scraper, good condition.
Austin-Western winch for above scraper, to fit any standard crawler tractor.
Ateco 5 yard scraper with hydraulic attachments for Cat. "60". Good condition.
Bell Wagon, 8 yard, working condition.
Page ½ yard dragline bucket complete, reconditioned and in excellent condition. Painted red.
Austin Western 80 Ft. crane boom for Badger Shovel with fairleads in good condition. Painted red.

GRADERS

Ryan 13 Ft. Grader, power controlled, leaning frame, steel tired roller bearing wheels, in operating condition.
Adams 8 ft. Grader with good solid rubber tires, roller bearing wheels, painted yellow. Good condition.

CRUSHING EQUIPMENT

Simplicity 2 deck screen, 3' x 6' without screen cloth, painted gray, excellent condition.
Niagara 2 deck 3' x 8' screen with 1" and 1¼" cloth on top deck, ¼" screen cloth on bottom deck. Rebuilt with new bearings. Excellent condition.
Austin-Western 22" x 14' revolving screen with 4 ft. sand jacket. Will be rebuilt and sold with guarantee.
Manistee 6" centrifugal pump, high head, triple stage, capacity 600 gal. per minute at 150 ft. head. Mounted on steel skids with factory rebuilt Hercules 80 H.P. motor, 4 cyl. Painted red and in excellent condition.
Waukesha 4 cyl. 40 H. P. Power unit complete with clutch, 10" pulley with Gates No. 710-C "V" belts. Painted yellow, very good condition.
LeRoi 4 cyl. Power unit on skids, Motor No. 20095, with 2 to 1 reduction gear and clutch, hood sides. No pulley. Painted yellow. In new condition.
No. 105 Austin Gyratory Crusher with back gear on steel tired trucks. Excellent condition.

TELFORD EQUIPMENT CO.
735 E. Kalamazoo St., Lansing, Michigan

FOR SALE — REBUILT EQUIPMENT

TRACTOR-SCRAPER

Allis Chalmers, Model L. O. Diesel tractor, Gar Wood 8 yard Hydraulic Scraper—$3750.00

BLADE GRADERS

Caterpillar No. 66, 12 ft. blade, Hand Control—$1000.00
Austin-Western No. 11, 12' blade, Hydraulic Control—$1250.00
Galion No. 210, 10' blade, Hand Control—$900.00

MOTOR GRADERS

Austin-Western, Model 77 Sr. Tandem drive, Diesel powered, 12 foot blade —$3500.00
Austin-Western, Model 66, Gas powered, Tandem drive, 12' blade—$2500.00

CRUSHER

1016 Austin Western, on steel wheels, 22' folding elevator and screen. Without screen — $1500.00. With Screen—New—$2200.00

POWER UNITS

Wisconsin Model K, 6x7, 80 h.p. with radiator, housing, clutch and pulley—$700.00
2—Wisconsin Model B 3, 5½x6½, 65 h.p. with radiator, housing, clutch and pulley—$650.00 each
Climax RI, 6 cylinder, 6x7, 150 h.p. Burns tractor fuel, radiator, housing, clutch and pulley—$1250.00

SHOVEL ATTACHMENTS

For Northwest Model 104—105 and 2

Send for our complete list

NIXON-HASSELLE COMPANY, INC.
1300 Carter Street
Chattanooga, Tenn.

FOR SALE

BUCKET, dragline, ¾ yd. Page Automatic.
BUCKET, dragline, 1 yd. Page Type M.
BUCKET, dragline, 2 yd. Omaha heavy duty.
CHAIN, 274 ft. of 1⅛" wrought iron dredge chain.
DRILL SHARPENER, Sullivan Class "C".
GRADER, Adams No. 12, leaning wheel.
GRADER, Caterpillar 10', pull type, hand control, leaning wheel.
MIXERS, Rex 7S and 10S.
PAVER, Koehring 27E-1A.
PAVER, 13E Koehring (⅓ yd.) on full crawlers, 20 ft. boom and bucket.
PILE HAMMER, No. 3 Vulcan.
PUMPS, 4" and 6" centrifugal.
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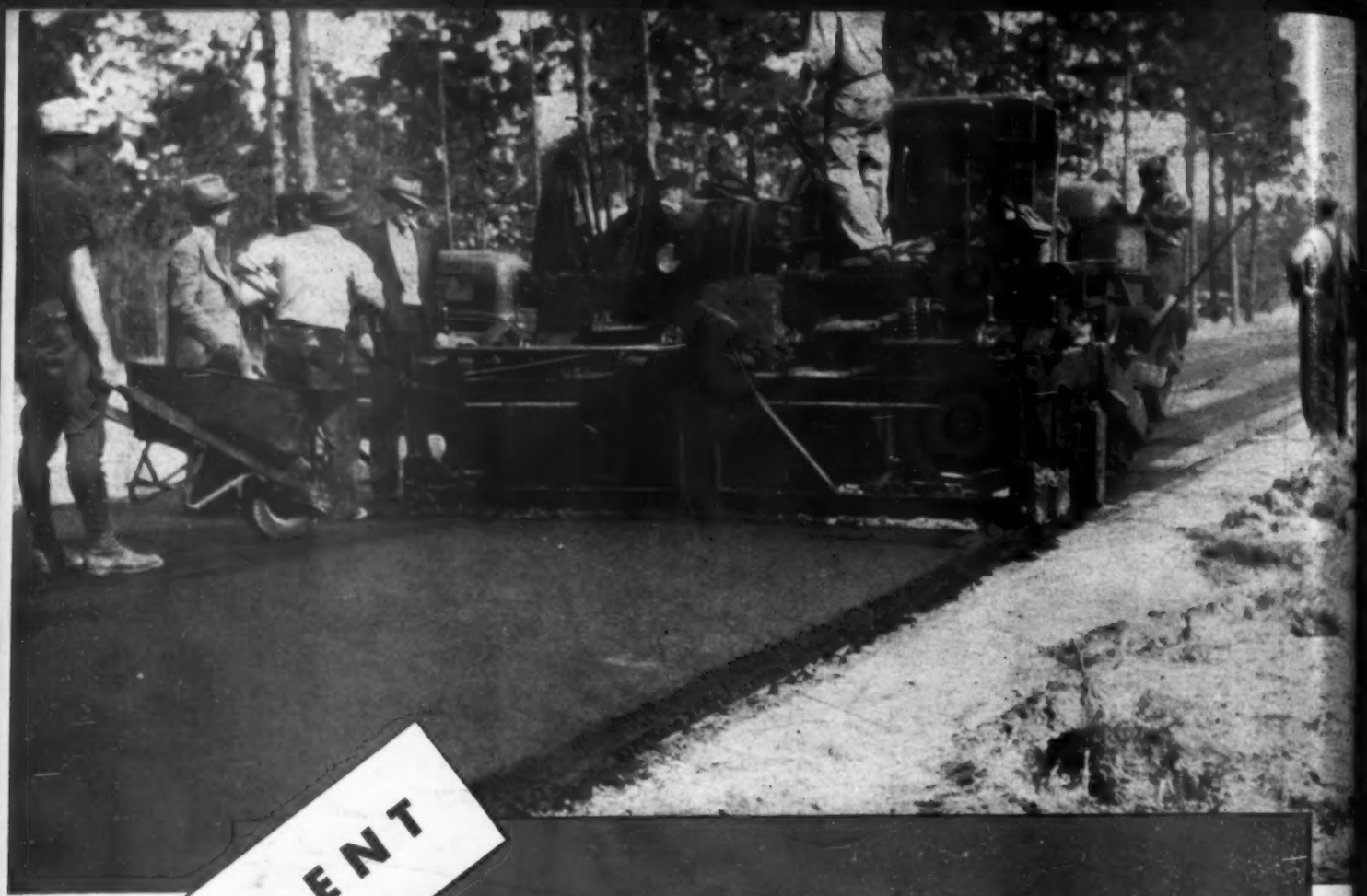

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